Night Picture of a Cratered Burning Gas Well at Alto, Louisiana
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This year marks the tenth anniversary of the establishment of the first Sharples dewaxing plant. It had a production of 4,000 gallons of finished oil per day.

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NEW YORK

Petroleum Engineer

The Engineering Magazine of the Oil and Gas Industry

Volume 1 FEBRUARY, 1930 Number 5

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THE PETROLEUM ENGINEER PUBLISHING CO.

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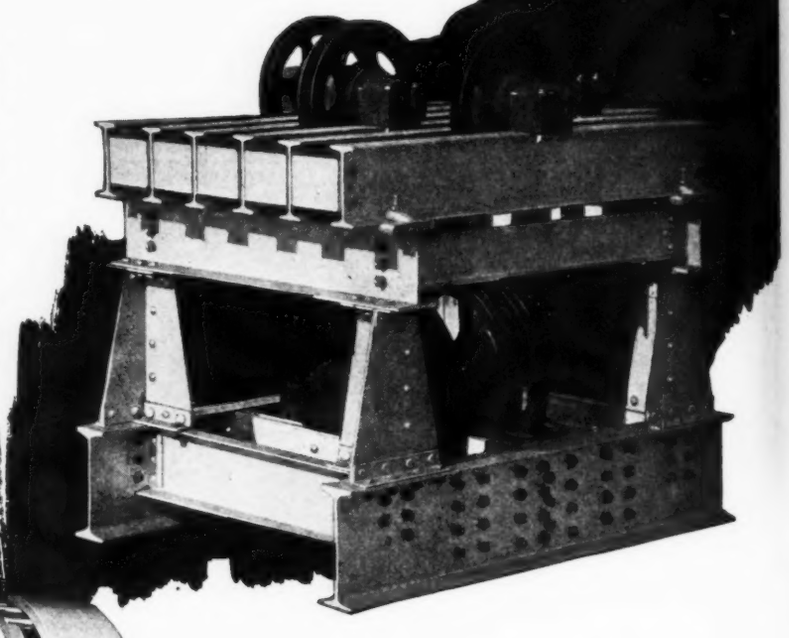
in building their newest crown and traveling



AS a distinct forward step in their manufacturing progress "Ideco" has announced the adoption of American Bearings for their newest crown block. This company thus becomes another member of the "All-American" team of drilling equipment manufacturers because their Boykin Division has been Americanized for some time.

The list of "All-Americans" below is the "Who's Who" of equipment makers in this industry. Their judgment recommends these Bearings for all heavy duty. And the Bearings recommend the products to the buyers and users.

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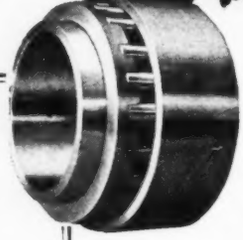

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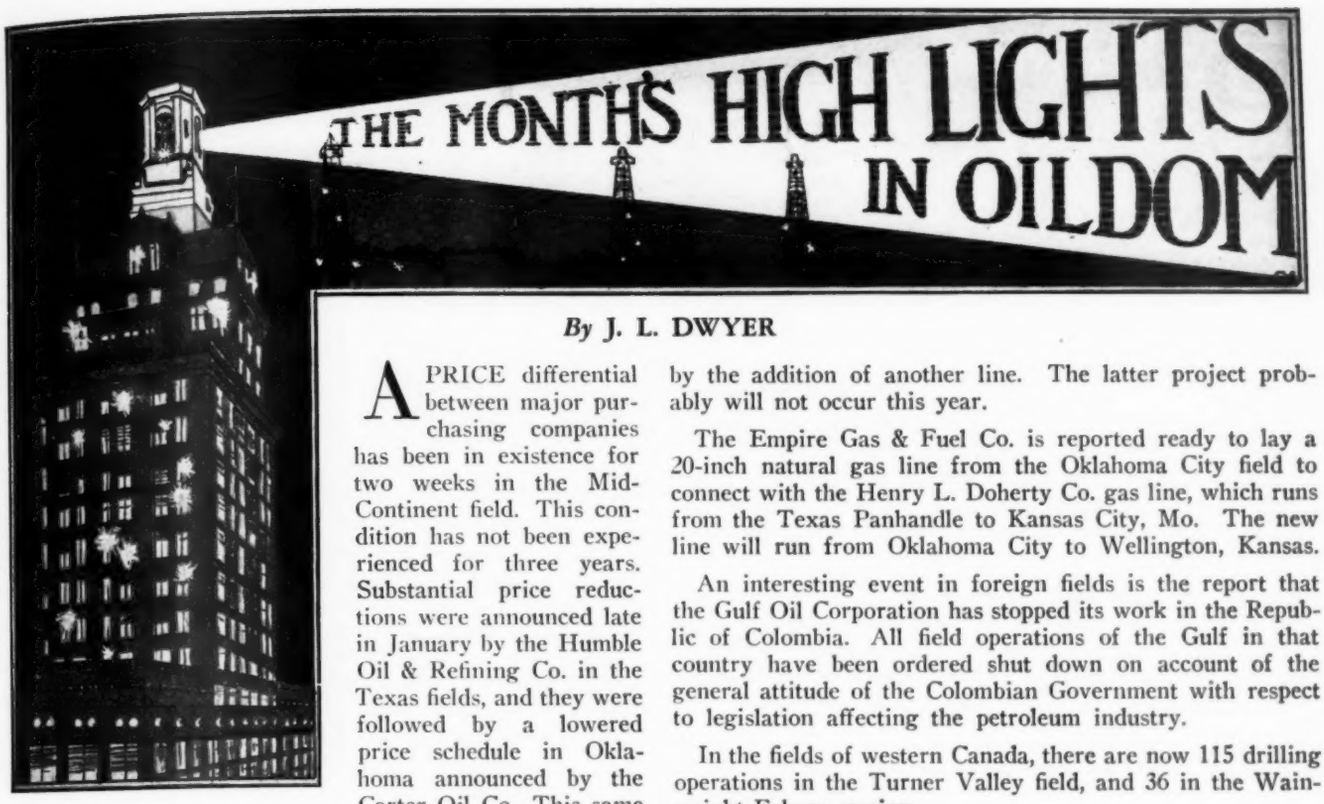


By J. L. DWYER

A PRICE differential between major purchasing companies has been in existence for two weeks in the Mid-Continent field. This condition has not been experienced for three years. Substantial price reductions were announced late in January by the Humble Oil & Refining Co. in the Texas fields, and they were followed by a lowered price schedule in Oklahoma announced by the Carter Oil Co. This same condition applied three years ago shortly after the discovery of the Seminole field of Oklahoma. At that time, there was a price differential in effect for about three weeks. The price reduction was inaugurated by the Carter Oil Co., and in three weeks was met by the other purchasing agencies.

There seems to be a rather extensive construction programme contemplated by some branches of the industry for the spring and summer of this year. Supply men and manufacturers' representatives report an unusual number of inquiries for equipment to be utilized in the construction of natural gasoline plants throughout Oklahoma, Kansas and Texas. The natural gas transportation branch of the industry seems destined for an active six months construction some time this year as there are numerous projects under consideration, some of which will materialize during the spring. The transmission of natural gas to the cities of Chicago and Omaha are very likely to become realities during the year; while there is some talk of increasing the present natural gas system from Monroe, La., to St. Louis by the addition of another line. The latter project probably will not occur this year.

The Empire Gas & Fuel Co. is reported ready to lay a 20-inch natural gas line from the Oklahoma City field to connect with the Henry L. Doherty Co. gas line, which runs from the Texas Panhandle to Kansas City, Mo. The new line will run from Oklahoma City to Wellington, Kansas.

An interesting event in foreign fields is the report that the Gulf Oil Corporation has stopped its work in the Republic of Colombia. All field operations of the Gulf in that country have been ordered shut down on account of the general attitude of the Colombian Government with respect to legislation affecting the petroleum industry.

In the fields of western Canada, there are now 115 drilling operations in the Turner Valley field, and 36 in the Wainwright-Fabyan region.

The Oklahoma City pool continues to climb in potential output if not in actual production, and the past month has witnessed the continued completion of wells having exceptional initial production. The present potential production of this pool is given at 500,000 barrels daily.

An interesting development of the month is the discovery of gas in a wildcat well in Woods County, Okla., at a depth of 6,700 feet. The significant part of this discovery is that the well is still in the Woodford formation, and should the Wilcox horizon be found, it will require 10,000-foot drilling.

The nation's production situation shows no basic change, and only normal variations occur each week. The daily average oil production hovers around 2,600,000 barrels, and were it not for the tremendous amount of production which is shut in, this figure would not be alarming.

The Van field in east Texas steadily increases in importance, and recent expressions indicate that there is now some doubt as to whether this field is a structure or a salt dome with the majority favoring the former theory.

Production and Refining Figures Furnished by the American Petroleum Institute

Crude Runs to Stills, Gasoline and Gas and Fuel Oil Stocks, Week Ending January 25, 1930

(Figures in Barrels of 42 Gallons)

DISTRICT	Per Cent Potential Capacity Reporting	Crude Runs to Stills	Per Cent Operated of Total Capacity Reporting	Gasoline Stocks	Gas and Fuel Oil Stocks
East Coast	100.0	3,362,900	79.3	7,043,000	7,477,000
Appalachian	91.0	512,800	62.9	1,472,000	738,000
Ind., Ill., Ky.	98.6	1,976,700	79.5	6,446,000	3,328,000
Okla., Kan., Mo.	89.1	1,935,900	67.2	4,211,000	3,136,000
Texas	90.7	3,881,100	78.6	7,739,000	13,062,000
Louisiana - Arkansas	96.8	1,299,700	70.9	2,553,000	4,291,000
Rocky Mountain	93.0	400,600	41.3	2,463,000	1,008,000
California	99.3	4,209,100	67.5	15,168,000	109,875,000
Total Wk. Jan. 25	95.5	17,578,800	72.0	47,095,000	142,915,000
Total Wk. Jan. 18	95.5	17,798,400	73.0	45,041,000	144,039,000
The Texas and Louisiana Gulf Coastal figures shown below are included above in the totals of their respective districts:					
Texas Gulf Coast	100.0	3,001,100	81.4	6,639,000	10,234,000
Louisiana Gulf Cst.	100.0	869,100	84.2	2,215,000	3,483,000

Daily Average Production

(Figures in Barrels)

	1930 Jan. 25	1929 Dec. 28	1929 Jan. 26
Oklahoma	655,550	647,550	723,650
Kansas	110,400	113,800	97,350
Panhandle Texas	88,150	102,600	61,200
North Texas	80,350	88,100	86,150
West Central Texas	56,250	54,000	52,750
West Texas	337,850	341,200	373,450
East Central Texas	21,150	23,550	20,700
Southwest Texas	67,450	74,950	43,500
North Louisiana	37,150	38,000	36,350
Arkansas	56,850	60,600	78,100
Coastal Texas	169,150	138,850	118,600
Coastal Louisiana	21,250	19,750	21,300
Eastern (not including Michigan)	124,600	128,200	107,600
Michigan	15,100	14,550	4,000
Wyoming	47,000	49,300	50,100
Montana	9,900	10,200	11,150
Colorado	4,600	5,400	6,850
New Mexico	10,650	7,700	2,000
California	702,200	689,400	768,300
Total	2,615,600	2,607,700	2,663,100

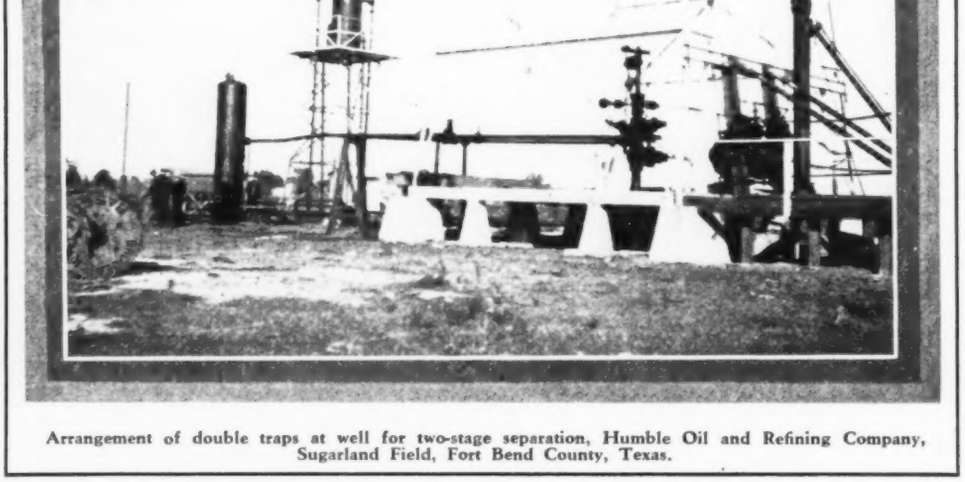
Preliminary Field Tests *where* Early Repressuring Necessary Is Planned

By K. C. SCLATER

IT is just a few years since the important role played by natural gas in the production of oil was accorded general recognition by the oil industry. At one time considered a necessary evil if found with oil under high pressure and in large volume, natural gas is now regarded as a valuable resource aiding in the reduction of lifting costs and in increasing the ultimate recovery of oil from the sand. Today the oil producer realizes the benefits that accrue from the wise use of natural gas energy and now keeps a close watch on the quantity of gas produced with each barrel of oil. Not satisfied with conserving gas by producing the minimum economic volume per barrel of oil, producers are going a step farther by making every effort to utilize as efficiently as field conditions will permit every available ounce of pressure that remains in the gas after it reaches the surface. One method of accomplishing this is by repressuring early in the life of the field where the conditions are favorable and the various property rights in the field can be reconciled. By making efficient use of the pressure still remaining in the gas as it comes from the well, the cost of boosting the gas to the high pressures necessary for the return of gas to the sand can be reduced to the point where it is no longer a stumbling block in launching the project on a successful economical basis. In this connection the value of preliminary tests in the field under actual operating conditions and the intelligent interpretation of the results in furnishing reliable data is seen in the adoption of a pressure maintenance program in the Sugarland field, Fort Bend County, Texas, by the Humble Oil and Refining Company.

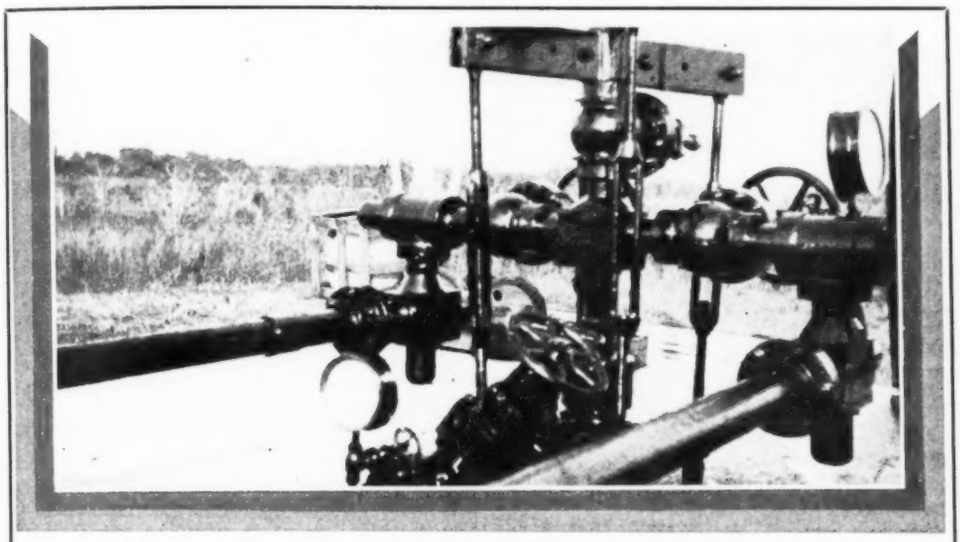
In this field the acreage is controlled almost entirely by the Humble Oil and Refining Company. Since the first well was completed in March, 1928, the field has been conservatively developed and today may be considered still in the flush stage of its producing life. These factors, among others, were favorable for the consideration of an early repressuring program for the field. Accordingly, in the late summer of 1929, an engineering study of the field was begun to determine the feasibility of returning gas to the sand at this early stage of its life while the rock pressure was still high. As a result of this study interesting data were gathered of a sufficiently conclusive character to justify the adoption of an early repressuring program for the field. The program as outlined provides for returning to the sand all gas produced, except that required for field operations, and the adoption of production methods and equipment to the end that low lifting costs and a maximum economic recovery of oil will result.

In the preliminary study all information regarding underground conditions, the daily production of oil and gas from each well, gas-oil ratios and well pressures, was obtained from carefully compiled drilling and production records. No definite information was available, however, concerning the rate at which the sand would take gas and the injection pressures necessary. Field tests were planned, therefore, to furnish accurate information of this nature. The important items of equipment used for this purpose consisted of two compressors with specially designed cylinders of 4½ and 4-inch diameter, respectively. The compressor with the 4-inch cylinder was designed for an intake pressure of 400 pounds per square inch, a discharge pressure of 2000 pounds per square inch and a capacity of 900,000 cubic feet daily, and the other with the 4½-inch cylinder for an intake pressure of 1000 pounds per square inch, a discharge pressure of 2025 pounds per square inch and a capacity of 2,000,000 cubic feet daily. Single trapping and double trapping methods of handling the gas at the wells was given some detailed study with the object of obtaining information concerning the most effective method of utilizing the available gas pressure and obviate, as far as possible, the use of multi-stage compression. (As used here the term single trapping refers to single-stage reduction of pressure in the separation of gas and oil at the well. Similarly, double trapping refers to two-stage reduction of pressure in the separation of gas and oil at the well. If only one trapper stage were used, then in a double trapping system both traps would be connected in series; but if more than one trap per stage were used, all traps in a stage would be connected in multiple and the stages in series. Thus the terms single trapping and double trapping refer to the number of pressure reduction stages and not to the number



Arrangement of double traps at well for two-stage separation, Humble Oil and Refining Company, Sugarland Field, Fort Bend County, Texas.

of traps or separators in use.) Well and trap equipment used in the tests consisted of a high-pressure trap and a low-pressure trap. Between the high-pressure trap and the compressor intake a scrubber trap, a 4-inch electric meter for gas measurements and a 10-inch drip were installed. In an entirely enclosed system such as the final plans would require, the importance of delivering clean, dry gas at the compressor intake was recognized, hence the precautions taken during the period of tests to duplicate as nearly as possible the probable conditions that would obtain in the final project. All connections, both at the well and the compressor plant, as well as the lines to and from the compressor, were welded. Before being put into use all discharge lines and connections were subjected to a cold water test of 3600 pounds per square inch. To maintain a uniform pressure on the casinghead of the producing well under test it was equipped with an adjustable type flow bean for ease in regulation. The scrubber trap was provided with suitable connections for dumping accumulated oil into the low-pressure trap or separator.



Casinghead connections with double bean setting on gas-injection well, Humble Oil and Refining Company Camp No. 3, Sugarland Field, Fort Bend County, Texas.

Camp No. 3 well of the Humble Oil and Refining Company was chosen as the injection well for the tests. Just prior to the tests it had been producing through tubing and a choke nipple at the rate of about 200 barrels daily, with a gas-oil ratio of 280 cubic feet per barrel. When the gas was turned into the well between the tubing and the casing the well was allowed to produce until the gas broke through at the bottom of the tubing. At this point the well was closed in. When the gas broke through the injection pressure was about 1150 pounds per square inch, and the final injection pressure required after the well was closed in was 1350 pounds per square inch. Injection pressures after running for some time were from 1350 to 1360 pounds per square inch. The volume of gas injected at this pressure was from 1,250,000 to 1,350,000 cubic feet daily. Gas was delivered to the compressor at pressures ranging from 400 to 480 pounds per square inch. As the gas was used in a closed cycle, passing from the producing well through the compressor to the injection well, gas measurements were taken on the producing wells only, and the volumes of gas handled calculated therefrom.

As a result of this study plans have been drawn up for and construction is now under way on the installation of an adequate gathering system together with compressor equipment capable of handling a daily gas volume of 16,000,000 cubic feet. This is based on a daily production of 25,000 barrels and an estimated gas-oil ratio of 640 cubic feet per barrel for the field.

A plat of the field showing the location of the compressor plant with respect to the wells in the field is given in Fig. 4. As the field is situated in a low-lying area in proximity to the Brazos River, ground elevation was an influencing factor in the choice of the compressor plant site. This explains the northeast-southwest layout of the compressor station.

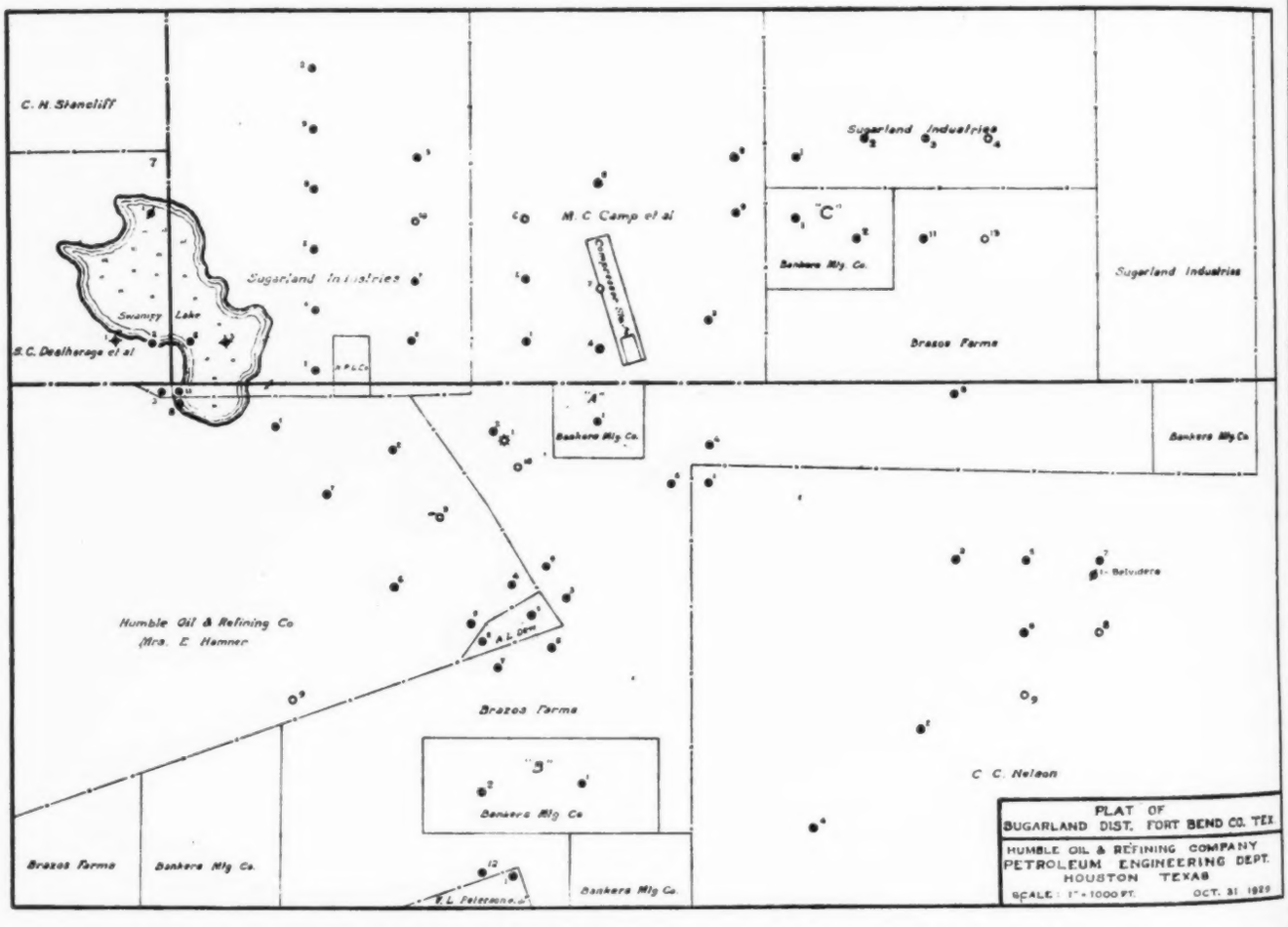
One of the interesting results arrived at was the determination of the conditions under which it was more economical to single-trap than double-trap the gas. Under the conditions existing in this field it was found that unless a well produced at the rate of more than 230,000 cubic feet of gas daily at a pressure of at least about 400 pounds per square inch, it was more economical to single-trap the gas and, by multi-stage compression, boost the pressure from 50 to 1400 pounds per square inch, than to double-trap the gas and compress it from an available well pressure of 400 pounds or more to a final pressure of 1400 pounds per square inch. These conclusions were arrived at from compression cost data obtained from actual experience and a comparative study of installation costs of single and double trapping equipment. Determinations of this character must be made for each field, as local conditions influence

High pressure compression plant used in preliminary engineering study of returning gas to the sand, Humble Oil and Refining Company, Sugarland Field, Fort Bend County, Texas.

greatly the costs on which they are based. An interesting feature of the gas-gathering system incorporated in the present plans is the layout of a low-pressure gathering line which will serve the double purpose of a low-pressure intake system for the compressors and a fuel system to serve the fuel needs of the field. By this arrangement all gas produced, with the exception of that required for field operations, will be returned to the sand with a minimum loss of energy. Gas lines from the high-pressure traps to the high-pressure compressor intake will be equipped with automatic relief valves which can be set to release any excess gas into the low-pressure gas-gathering system. Provision has been made for tying in additional wells as they are brought in. Each well will be tied into the low-pressure fuel system by a permanent line. Extra injection wells can be added to the system if found necessary, and the installation of extra compressor equipment made conveniently at a minimum of cost.

Conservation of gas pressure between the well and the compressor intake has been the foremost thought kept in mind in the design of gathering lines and trapping systems for the gas. By employing a well-designed double trapping system the gas pressure can be maintained at a high value until it enters the compressor intake. One of the chief advantages of the system is the big saving in compression costs that can be accomplished. Where low-pressure gas is used in a repressuring project requiring high injection pressures, compression costs may be prohibitively high. Aside from the reduction in compression costs, there is another factor that, from an operation standpoint, favors separation of gas under high pressure in this instance. There is a reduction in the amount of gasoline vapors that will be carried over with the gas, hence there will be less condensation troubles in the lines and the compressors. It is quite common for large volumes of gas to be produced in the flush production period of a field. Much of the gas energy represented in large volumes of high-pressure gas could be put to profitable use by the installation of efficient gas separation or trapping systems. The preliminary work done in the Sugarland field on this problem has shown that tremendous savings in compression costs are possible where the repressuring possibilities of a new field producing appreciable quantities of gas and oil look at all favorable.

It is probable that recent drastic curtailment of development and producing operations will necessitate the modification of the original estimates of the volumes of gas that will be handled in the repressuring project in Sugarland field. However, this should not mean a departure in principle from the plan of operation evolved as a result of the test data furnished by the preliminary test work. Figures of installation costs of the project and the estimated reduction in lifting expense and increased ultimate recovery that result from this pioneer early repressuring program in a Gulf Coast field should be productive of much valuable information and, together with the operating data, should throw some light on both the practical and economic value of this comparatively unknown phase of oil field practice.



Plat showing location of Humble Oil and Refining Company's compressor plant, Sugarland Field, Fort Bend County, Texas.

Manufacture of Motor Oils *for* Winter Use

By F. R. STALEY

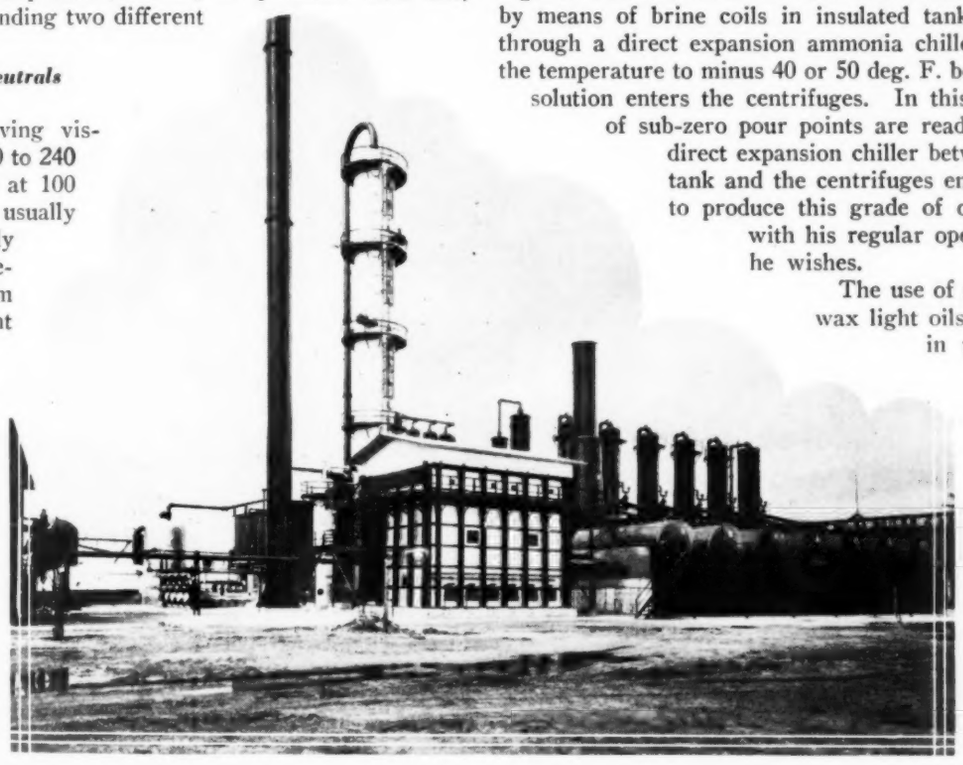
LOW viscosity motor oils having zero or sub-zero pour points are now manufactured by many refiners as the most suitable for winter driving conditions. The motorist considers easy starting in cold weather a primary function of winter motor oil, and consequently this feature is a salient selling point. These oils have S. A. E. viscosity numbers of 10 or 20, or from 200 to 300 seconds Saybolt at 100 deg. F.

Winter Driving

During very cold weather most automobiles are driven only comparatively short distances at much lower speeds than in summer touring, and consequently volatility and oil consumption are not very important considerations. Due to this fact most winter motor oils are made by refining distillates from naphthene, mixed, or paraffine base oils, and often by blending two different base oils.

Zero Neutrals

Neutral oils having viscosities from 200 to 240 seconds Saybolt at 100 deg. F. have usually sold at relatively low prices, especially those from Mid-Continent crude oils. Due to their wax content the pour points of these oils are so high that they are unsuitable for winter use, while their low viscosities and high volatility limit their use in blending summer motor oils. Consequently naphthene base oils having pour points below zero degrees F. were preferred for blending winter oils.



A topping plant in Oklahoma.

As the viscosity-temperature characteristics of an oil have a decided effect upon the starting effort, the paraffine base oil should be superior as its viscosity does not increase as rapidly at lower temperatures. As a result, some refiners are realizing greater returns by dewaxing neutrals to zero pour points.

Dewaxing Neutrals

Various methods can be used to produce low pour point neutrals. The older procedure is the so-called double pressing method. After the wax distillate has been pressed the first time it is again chilled to a sub-zero temperature and run through the wax press a second time. Unless nearly all the wax is in a crystalline state it is difficult to obtain pour points below 10 deg. F. by this method.

The centrifuge can be employed very effectively in the manufacture of these neutrals or motor oils of low viscosity. It is especially good for those refiners not having wax plants, who dewax all their lubricating oils as long residuum. In such a procedure the wax is nearly all in an amorphous state. The neutral oil is blended with the long residuum in naphtha solution. The ratio of neutral to residuum is not of great importance, as it is only necessary that enough of the undewaxed residuum is present to furnish sufficient wax to maintain a layer in the bowl of the machine. Usually from 60% to 70% of naphtha is used in the blend for chilling. The solution is chilled down to minus 20 or 25 deg. F. by means of brine coils in insulated tanks, and then run through a direct expansion ammonia chiller which reduces the temperature to minus 40 or 50 deg. F. before the naphtha solution enters the centrifuges. In this way motor oils of sub-zero pour points are readily obtained. A direct expansion chiller between the chilling tank and the centrifuges enables the refiner to produce this grade of oil in connection with his regular operation whenever he wishes.

The use of a filter aid to dewax light oils is very effective in removing mixtures of both crystalline and amorphous wax. This process, however, is limited in its use since it is regarded as a more expensive procedure in its present state of development than the others described. At the present time it is being studied by the research men of many companies. The oil is chilled in naphtha solution to the desired temperature, and from 0.2 to 1 pound of special filter aid is then added per gallon of oil. The mixture is kept agitated and pumped to a filter press to remove the wax. There is some mechanical difficulty in pumping the filter aid mixture, and the recovery of the wax involves another step in the process. The coke is washed with warm naphtha to remove the wax and the filter aid can be used repeatedly. For the same naphtha solution the temperature difference between the pour point of the dewaxed oil and the chilling temperature is about the same in this process as in centrifuging.

The use of selective solvents for dewaxing oils has been

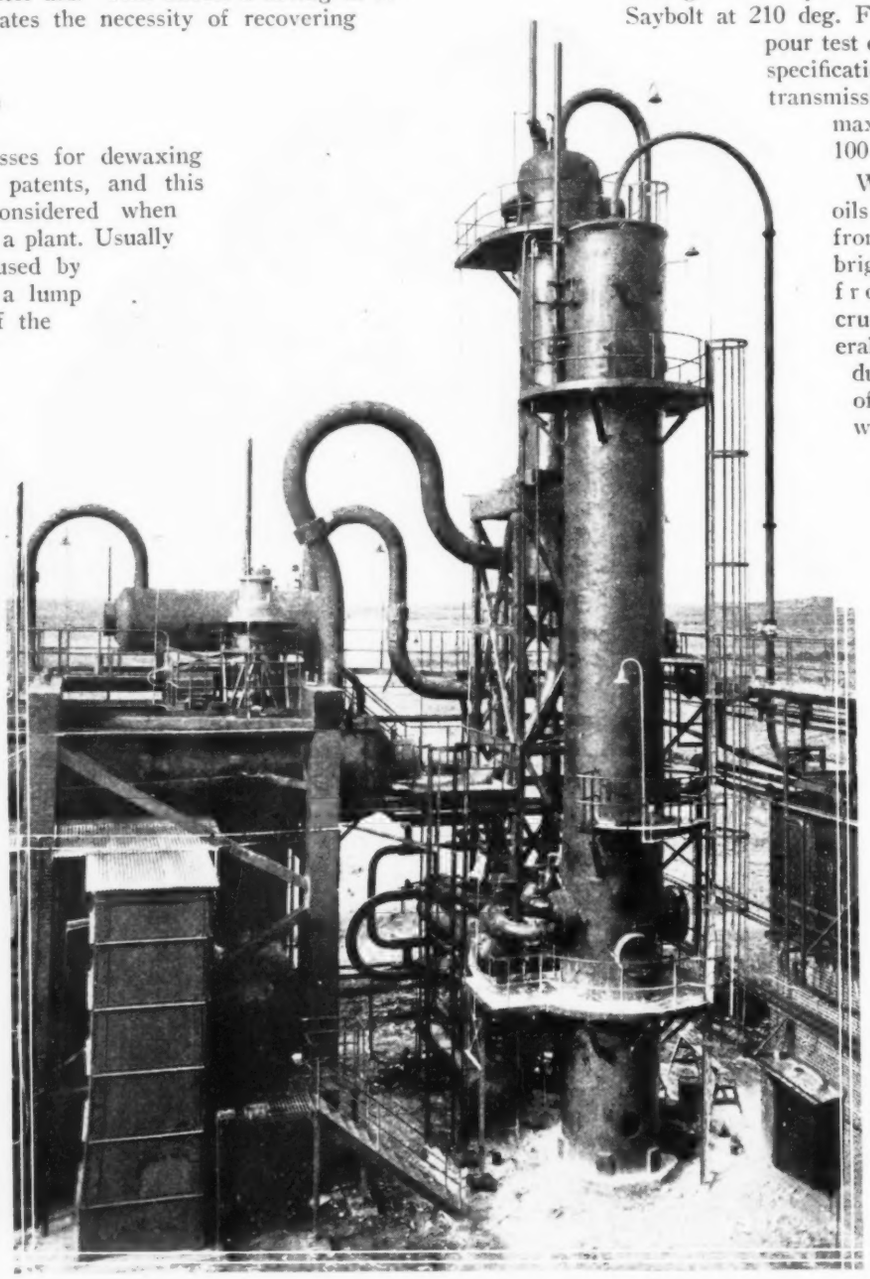
extensively studied in recent years, but as yet commercial installations of this type of process are very limited due essentially to the high cost of solvents other than petroleum naphtha. The higher alcohols, ketones, and benzol mixtures are effective. By their use the waxes can be more completely precipitated from solution at higher temperatures than from naphtha solution. The wax can usually be filtered without the use of a filter aid. This effects a saving in refrigeration and eliminates the necessity of recovering a filter aid.

Patents

Many of the processes for dewaxing oils are covered by patents, and this aspect should be considered when studying or installing a plant. Usually the method can be used by paying a royalty or a lump sum to the holder of the patent rights.

Petrolatum

The petrolatum or wax obtained from centrifuging a bright stock, contains as much as 30% or 40% naphtha. At the present time the market for this product is very limited. The usual procedure is to recover the naphtha by distillation in a steam still and then to burn the petrolatum as fuel or to mix it with gas oil for charging stock to the cracking units. It cracks very readily, giving a high gasoline yield with very little coke formation, contrary to the opinion of some refiners. Usually the petrolatum from the centrifuge does not contain as much oil as that from the cold settling process, and consequently cannot be used in grease manufacture very advantageously.



Richardson Refining Co. plant in West Texas, showing circulating motor, reflex and bubble tower.

Compounded Oils

Some refiners compound their winter motor oils with a small percentage of aluminum soap to reduce the A. S. T. M. pour point, or blend them with a vegetable or animal oil. The use of the soap has the disadvantage that it is decomposed by moisture in the crankcase, and while the pour test might be lowered it is questionable if the oil will show better performance in cold weather because of its presence.

Transmission Oils

Winter transmission and differential oils are usually preferred to greases and compounds in cold weather. The S. A. E. specifications cover Special Winter, No. 90, having a viscosity from 80 to 100 seconds Saybolt at 210 deg. F. and a maximum pour test of 10 deg. F.; No. 110 Winter having a viscosity from 100 to 120 seconds Saybolt at 210 deg. F., with a maximum pour test of 15 deg. F. Some specifications for winter transmission oils specify a maximum viscosity at 100 deg. F.

Winter transmission oils are sometimes made from low cold test bright stocks refined from paraffine base crudes, but most generally from certain reduced crudes, the bases of which contain no wax and consequently they have a low pour point.

Research and Development

At the present more attention is given to dewaxing neutral oils and bright stock than ever before. Huge sums are being spent by refiners for the installation and improvement of plants, and many petroleum technologists are studying new methods.

In order to prepare an oil for dewaxing by a certain method, attention must be given to the distillation process and type of still used, as the wax structure might be so changed in distillation that the dewaxing process would be inefficient in removing it.

Refrigeration

Since refrigeration is one of the important items of cost in dewaxing oils, considerable care should be given to this plant. Proper insulation and heat exchangers should be used in order to minimize losses. In most cases a good refrigeration engineer can save many times his salary. Too often little attention is given to this feature of the installation and operation.

Sulphur Crude as a Cause of Pipe Line Equipment Corrosion

By J. H. DAMERON

GRUDE oil transporting companies operating in the West Texas area and using sulphur contaminated crude oil for Diesel engine fuel, are experiencing a great deal of unusual trouble because of the corrosive action of the fuel on engines and equipment. Consequently the maintenance costs of these stations is considerably more than that of stations using sweet crude for fuel, and the loss concurrent with shut downs is greater because of the more frequent and longer shut down periods.

West Texas crude often contains as high as eight per cent by volume hydrogen sulphide along with a small amount of water and B. S. To an extent the troubles following the use of sulphur crude as an engine fuel have been overcome by various methods, but West Texas still remains a proving ground for many new plans to eliminate the several and costly corrosion problems peculiar to stations using that kind of crude as engine fuel. However, the several methods adopted to overcome individual problems seem, in the aggregate, to aid considerably in improving the condition as a whole.

The first of the long string of faults charged to the sulphur contaminated crude as a Diesel fuel, came when the atomizing systems failed to stand up under the attacks of the sulphur oil. In some instances the atomizers burnt out in the short period of 24 hours on the smaller type engine. This was improved to some extent with the substitution of stainless steel for the brass parts. However, several other factors have undoubtedly aided, such as using a settling tank for fuel and running fuel oil through a centrifuge.

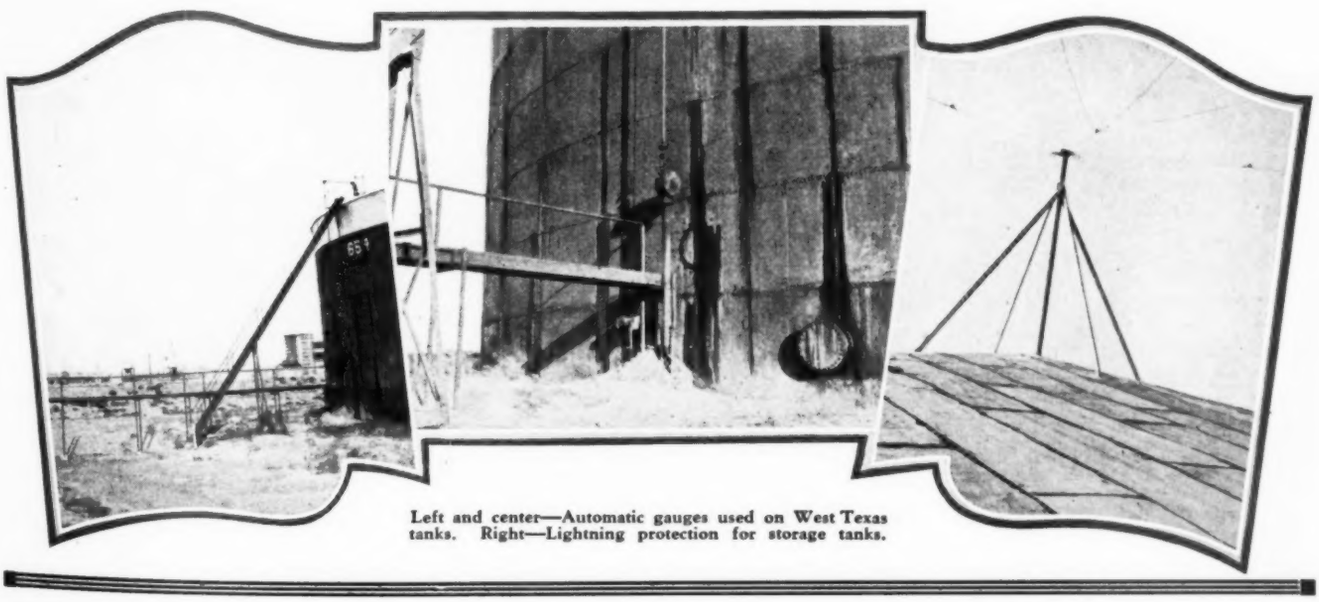
The fuel lines were another source of trouble mainly, it is believed, because the oil traveled through the line so slowly that the hydrogen sulphide and water in the crude had the chance to start destruction in the line. Fuel lines frequently failed after a relatively short period of use. Some of the lines lasted four years or more and others only two years.

This trouble was corrected to an extent by installing wrought iron pipe in the fuel line.

It has been noted oil engine stations have shown quite an improvement in the performance of engines soon after the method of handling fuel oil was changed. Several stations are using two fuel oil storage tanks instead of one which permits oil to be drawn from one tank while that crude oil in the other tank is given approximately 24 hours to settle out the water and B. S. to some extent. Each tank is equipped with a drain cock, and every morning this is opened before that particular tank in use is turned into the fuel lines. The fuel oil is then passed through a filter before going into the engine. This one method alone helped considerably.

All the fuel oil for several oil engine stations is now running through centrifuge machines, and many pipe line engineers are hopeful this will further alleviate a great many of the troubles. On tests it has been found the centrifuge machines have improved the quality of the fuel to a marked degree. By centrifuging the fuel, water and B. S. were removed from the oil and after going through the machine the sulphur content of the crude was lowered. Many of the engineers are of the opinion that by the removal of all the water from the crude the corrosion action is greatly reduced, because in the absence of water an acid condition is eliminated.

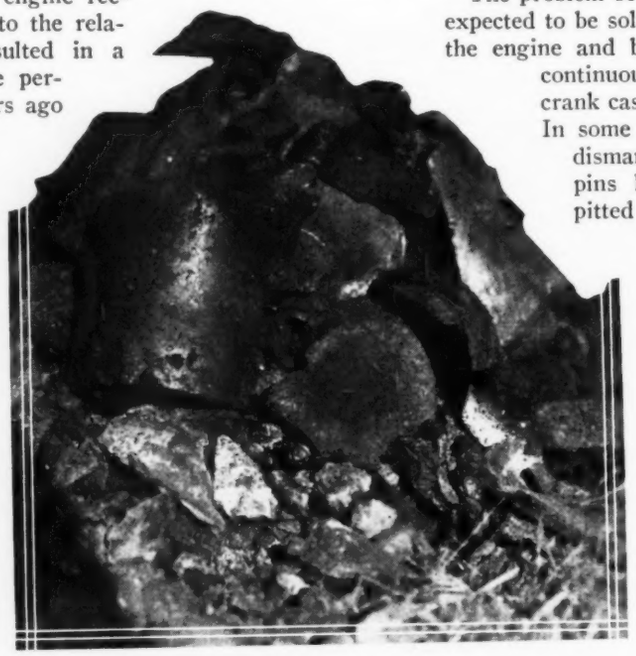
The practice of centrifuging fuel oil in West Texas has not been carried on long enough to determine the true value



Left and center—Automatic gauges used on West Texas tanks. Right—Lightning protection for storage tanks.

of the method. However, during the short time this practice has been followed there is evidence to those keeping records that the centrifuging fuel oil will play an important part in conquering the problems attendant with the use of sulphur oil as fuel.

During the past four years engine records show that close attention to the relatively small problems has resulted in a distinct improvement in engine performance. Two and three years ago the smaller engines had a record of running 500 or 600 hours before it was necessary to shut them down for any length of time for repairs. Now these same engines are running anywhere from 900 to 1200 hours on an average before it is necessary to shut them down. In one of the stations a small engine made 2100 hours before being shut down. However, the fuel oil alone was not responsible for the relatively short runs before a shut down. The engine cooling water problem was another of the many that proved costly. The scale in the jackets frequently had an engine down because of a cracked head, and until a proper method of treating or continuous circulation was worked out this was a constant source of trouble.



A pile of foreign matter removed from Diesel engine oil.

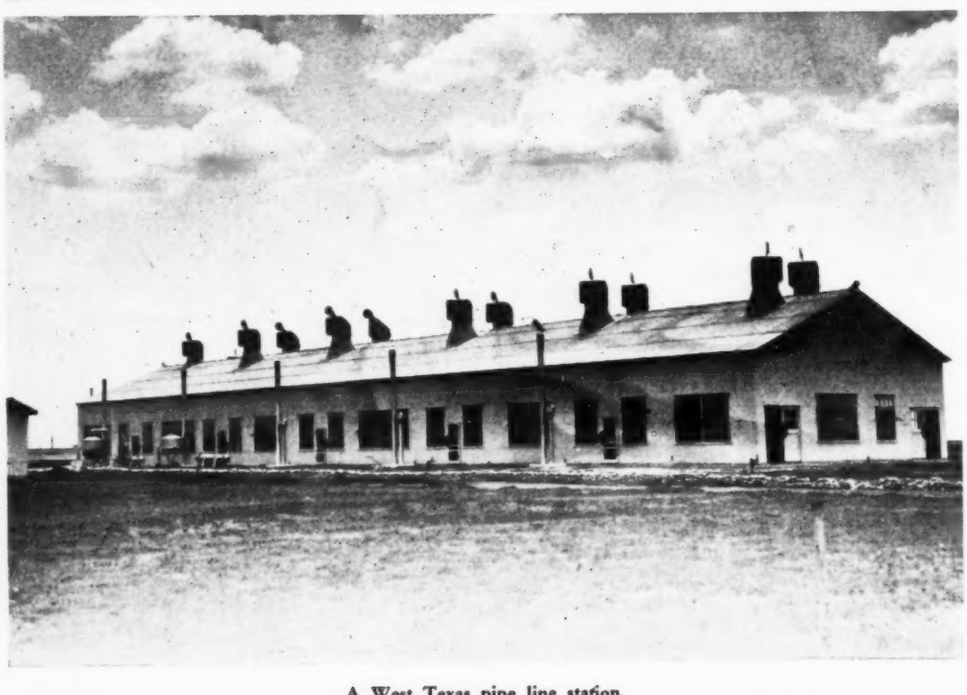
The more expensive problem coming as a result of using West Texas crude as a fuel, is in the comparatively excessive liner wear on the Diesels. In some instances it has been found necessary to replace the liner after about one year's service. Liners were found to bell out excessively and rapidly on the firing end. One company keeping a record of liner wear over a period of several years, found that the West Texas engines had an average run of 232 hours per .001 inch year. This same type of engine operating at virtually the same load as the West Texas engine but fuelled with sweet crude had a run of 1035 hours per .001 inch liner wear.

This particular trouble has been alleviated to some extent with the use of special lubricating oils. Some of the companies are seeking to remedy the condition by the use of liners constructed with metal designed to have greater resistance against corrosion. Some are hopeful that the centrifuging of fuel oil will go a long way toward correcting the condition.

The problem of crank case oil contamination is expected to be solved by getting a cleaner fuel to the engine and by running lube oil through a continuous reclaimer or cleaning the crank case oil at more frequent intervals. In some of the engines that have been dismantled, the crank shaft and wrist pins have been found to be badly pitted due, it is believed, to water condensing in the crank case and mixing with the sulphur, causing a diluted form of sulphuric acid. The presence of the water in the crank case is believed to accelerate the dilution of the oil and corrosion. An example of how rapidly crank case oil can be contaminated is found in a case where an engine broke a piston ring. Before the unit could be shut down the case of new oil was contaminated to such an extent that it was found necessary to change it.

Pumps that have been handling West Texas crude for the past four years do not as yet show any serious trouble from corrosion and are not expected to. All of the packing is heavy duty material and designed to withstand corrosion.

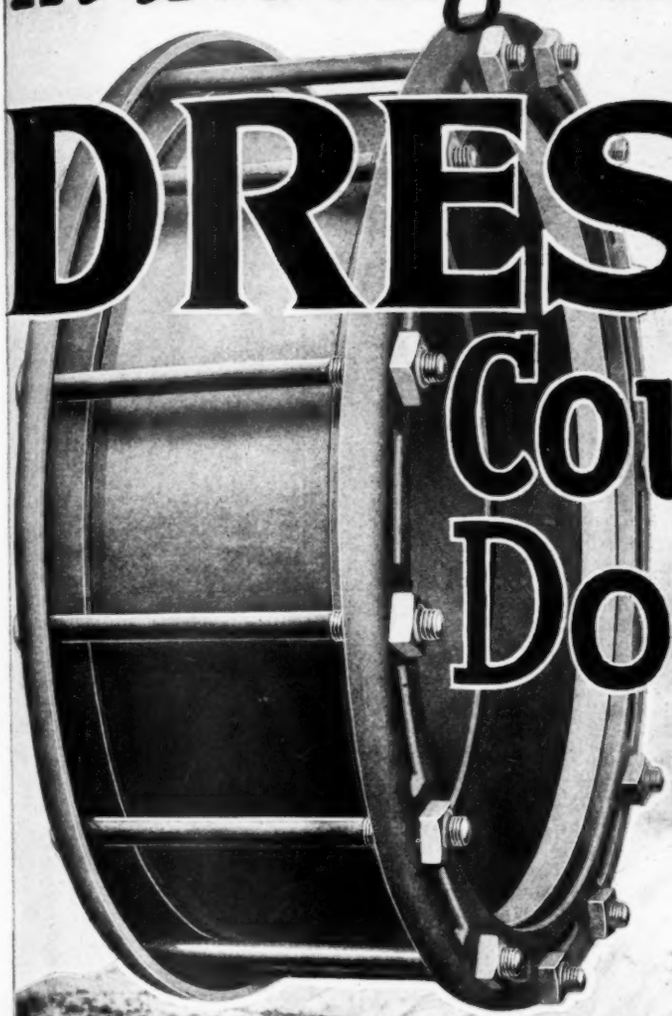
Another problem confronting the pipe line companies is that of working out plans to extend the life of their gathering systems. Almost every gathering system in West Texas that has been in service an appreciable length of time is showing the effects of corrosion. The best example of the corrosive action of West Texas oil moving through lines at slow speed is found in the Reagan County Purchasing Co.'s line from the Big Lake field to its tank farm near Kemper Station. After approximately five years' service, this line had to be replaced almost every foot of the way because the joints had been attacked from the interior and corroded through



A West Texas pipe line station.

In the Higher Altitudes

DRESSER Couplings Dominate!



Here is a short section of the Amarillo to Denver 22″ Dresser coupled high pressure natural gas pipe line. Its extreme flexibility is obvious, and after one year of service its absolute tightness and reliability under extremely high pressures and severe operating conditions have been demonstrated.

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the walls of the pipe. Corrosion was first noted in the sags of the line, and to extend the life of the pipe, the corroded joints were given a half turn placing the weak part at the top. The line is operated at low-pressure and it was practical to do this.

One of the transporting companies had an ideal condition in the Church and Fields Pool for a gravity system, but rather than take advantage of gravity and be confronted with the possible necessity of replacing the entire system in a few years, the company decided to use suction pumps to gather the crude. To further retard interior corrosion, it is the practice of the company to pump fast and keep the lines clean.

A pump station of The Texas Company.

There are several six, ten and twelve-inch suction lines put in during the flush period that are not now operating near their capacity of the flush period. On other gathering systems that are taking the crude from the settled producing wells, transporting companies are casting about for a method of gathering to retard corrosion in those lines. Several plans have been suggested. One is to use one line one week and another the next, in this manner operating one line at capacity every other week. Another plan is to circulate the oil through the entire gathering system at a more rapid rate. Gathering lines that are out of service for any length of time are subject to more rapid corrosion from the interior than those used more regularly. To protect these lines, some companies intend to fill them with water and others plan to fill their lines with an alkali solution.

While no great trouble is expected from interior corrosion on the main lines, virtually every transporting company is keeping an accurate record of all the leaks found and the causes. To date no definite evidence of interior corrosion on main lines has been found, and this has led to the belief that trouble from interior corrosion on main lines will be delayed until such a time as those lines will operate at reduced pressures and loads.

In point of service in West Texas, the Humble Pipe Line Co. is the pioneer transporter. Their first line was an eight-inch screw line built from Kemper Station to Comyn Station. This line was put in operation in May, 1925. Every leak that has been repaired in the line since that time has been closely examined to determine whether or not interior corrosion is active, and, without exception, no leak has been found that originated from interior corrosion. Last summer this line was closely examined over the entire distance from Kemper to Comyn Station. Before being buried, it was painted with a light coat of paint to protect it from soil corrosion. When the inspection was made, the line was found to be in good condition and no evidence was discovered that would lead to the belief that internal corrosion was taking place. The method of inspection required a bell hole to be dug every 500 feet. Whenever such a hole was dug it was usually about 10 feet in length to permit a good inspection to be made. A few leaks were found and it was necessary to replace a few joints of pipe. But in each instance these leaks were caused by external attacks.

One interesting discovery made during this inspection was that where the oil was leaking at some of the couplings it would run down beneath the pipe. If this leak happened to be in a low place in the line where soil water is usually present, it usually meant the joint was bad the entire length of the oil-soaked ditch. Where there was no water present under such a condition, the corrosion was not bad, but in a few cases it was found necessary to replace entire joints. Such a condition as this is not confined to West Texas crude only. Lines operating with sweet crude and developing coupling leaks have shown very rapid corrosion when the leaking oil came in contact with soil water.

Storage tanks in West Texas.

Whatever may be the ultimate result of corrosion to the interior of West Texas pipe lines, the engineers will be fortified with an excellent set of records in most instances to further study the corrosion problem. It is a problem which for a time baffled all attempts of equipment manufacturers and engineers to solve, but much progress has been made.

Causes and Prevention of Crooked Cable Tool Holes

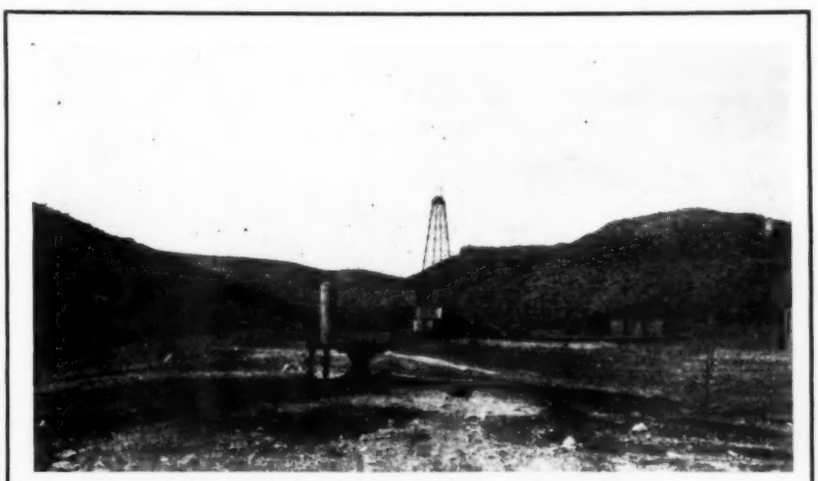
By HAROLD N. PARDEE [1]

IT is now recognized that a hole drilled with cable tools is just as liable to be crooked as one drilled with rotary tools, unless ordinary precautions are taken to prevent it. One source of trouble lies in the construction of the derrick, in getting it properly balanced and in correct alignment. If the derrick and rig are not lined up properly, there is danger of starting a slanting hole, one that deviates some degrees from the vertical. This can lead to very serious trouble deeper in the hole, such as improper casing seat, line-cut pipe, excessive wear and tear on tools and drilling equipment, and even may result in missing entirely the pay formation. In addition to these hazards, the probable high cost of continuing a crooked hole should be considered. To avoid starting a hole crooked, the operator should use due care and precaution, and insist on the rig and derrick being properly constructed, properly balanced, and in perfect alignment, with sufficient footing under the derrick corners to prevent settling after drilling operations are under way. With the derrick and rig equipment in good alignment, attention then should be given to the proper stringing up of the tools. The drilling crew should see to it that the crown block is placed so that the tools, when suspended from the top of the derrick, hang true to the center of the derrick floor, and in line with the main sill and beam. Once this is done the action of the tools should come in for observation. While spudding or starting the hole, it is well to make provision for supporting the tools securely in the derrick to keep the stem from wabbling. This will insure the bit being held in a vertical position at all times. Close adherence to these preparations and precautions will go far toward starting a hole straight. Under ordinary conditions, it is not a difficult task to guide the tools in this manner. When the hole is started in hard lime or hard formations, however, it is more of a problem to keep the tools from wabbling, especially if too short a stem is used.

Harold N. Pardee

Before starting to spud, a close examination should be made of the condition of the bit. It should be dressed full and out to gauge. To get the very best results, the bit should be dressed to that the water courses are free from surplus steel, the corners full and square, and drawn out practically even with the points of the bit. A short sharp cutting bevel should be shaped on the bottom of the bit. This is most essential in drilling hard formations. Care should be exercised not to get too long a bevel. To do so might result in a crooked hole or a fishing job. A long bevel on bit may result in breaking the pin off, which in many cases has caused the loss of the hole. Besides running this risk, there is the possibility of drilling crooked hole, particularly if the driller is running too loose and with too little motion. To avoid these conditions the bit should be kept properly dressed at all times, run at proper speed and with a "tight" hitch on the tools. In other words, the tools should not be crowded ahead too rapidly.

It seems appropriate to discuss here "tight" and "loose" drillers, in connection with the "making" of hole. The writer wishes to state that the "tight" driller, with a properly dressed bit running at the proper speed, very seldom gets into serious trouble. There is much less danger of a crooked hole due to the fact that the tools are picked up sufficiently high off bottom each stroke of the beam to permit thorough churning of the formation cuttings. The danger of a crooked hole is not only lessened, but a good, clean, round hole is more likely to result by following this practice. The "loose" driller, on the other hand, invites trouble every stroke of the bit. For example, if he feeds the screw too fast or slips the line through the clamps too far the tools are not picked off bottom sufficiently high to allow the bit to function properly and thorough mixing of the formation cuttings does not occur. This condition produces a "flat" hole because the tools are prevented from revolving freely in the hole. If the formation has a steep dip the tools naturally will take the line of least resistance, and follow down the dip, causing not only a flat hole, but a crooked one as well.



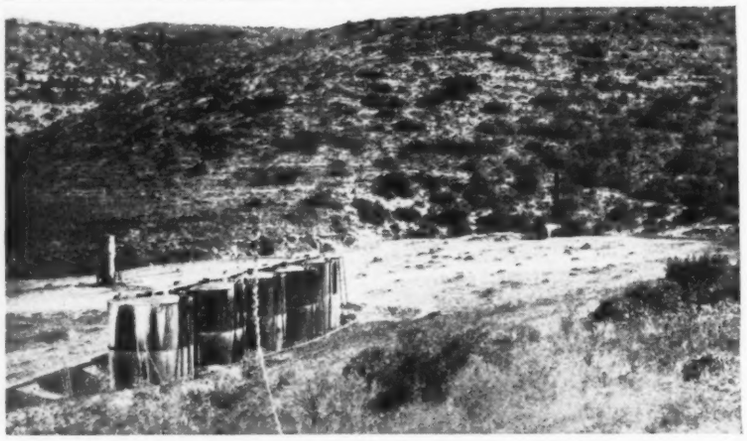
The Yates Pool discovery well in Pecos County, Texas.

In recent years it has been the custom in many fields, particularly during a boom, to discontinue the use of the temper screw, and let the drilling line slip through the clamps. This practice should be discontinued for it not only invites crooked holes, but causes unnecessary and expensive fishing jobs, and adds to the cost of the hole because of the damage to drilling lines. This is a bad practice, and one of the worst evils

[1] Assistant Division Manager, The Texas Company, Tulsa, Okla.

in cable tool drilling. Slipping of the line through the clamps also presents a serious fire hazard, particularly when used in drilling in oil or gas wells. Under such conditions this practice has cost the lives of many good men just because of neglect, lack of forethought, or ignorance, occasioned by taking a chance in an effort to make a few extra feet of hole on a tour. Aside from being the prime cause of many crooked holes, it has cost operators thousands of dollars of destruction by fire.

After the hole once starts going off vertical and drilling



In the Yates Pool, West Texas, where cable tools dominate.

continues, it has a tendency to slow up the progress of the drilling, the tools do not drop freely, they ride the side of the hole, and it is the writer's opinion that the string of tools become crystallized and weakened thereby. This may result in breaking the pins off bit or jars, or be the cause of the jars breaking, producing a serious fishing job. However simple a fishing job may seem, the ultimate result may be serious. It may mean the total loss of the hole. When the hole is crooked, tools and line wear rapidly, especially while drilling in sandy formation. This all results in increasing the cost of drilling operations, and as stated above, may result in the total loss of the well. When running the casing to shut off water in a hole of this kind, we often wonder—not knowing that the hole is crooked—why we cannot get the proper shut-off. A good casing seat cannot be made if the hole deviates from the vertical to any great extent. In trying to effect a water shut-off in such cases the hole has been lost. This has happened not once, but many times and usually can be attributed to a crooked hole. For instance, while trying to get a good shut-off it is desired to ream a new seat. The reamer is run through the casing and a new seat made. In trying to withdraw the tools it is found that the reamer will not come back into the casing. What is the final result? Usually the bottom joint is knocked off or the lugs of the reamer lost. Many other things of this nature could happen, with the ultimate result, delays, expensive fishing jobs, and maybe a lost hole. Even if the casing has been properly seated, it may be badly line cut, necessitating the lowering of an additional string, or may have resulted in a condition such as that which was pictured[1] in the December issue of this magazine.

Drilling conditions such as those discussed can be controlled more or less. Considerable improvement can be noted in the technique of drilling in recent years due to the petroleum engineer and the practical field man getting together to solve their drilling problems. These problems are being solved rapidly, and drilling costs, both cable-tool and rotary are being reduced materially thereby. The writer had occasion recently to observe several tests with rotary tools. It was very interesting to note the variance in the holes off vertical under different instructions to the drillers on the wells. The wells mentioned were all drilled in the same area under similar conditions, with practically the same type of equipment, each unit being equipped with pressure gauges, recording gauges, etc., and all started within a few days of each other. Each hole was started with the idea of having it straight. When completed, they were all, with one exception, within four degrees of the vertical. One hole, the exception, was drilled more rapidly than the others, less attention was paid to the recording gauge due to the fact that the offset well had considerable lead and it was the driller's idea that the hole should be pushed rapidly in order to be completed by the time the offset was. The result was it attained a maximum of 80 degrees off vertical. This brings us back to the driller on the well, and the writer is inclined to believe that the driller can solve the principal part of our troubles in drilling crooked holes.

With the weight indicator, the pressure gauge, the proper consistency of mud fluid for circulation, and the careful attention of the driller, there is little reason for the hole to be off vertical but a few degrees. This assumes, of course, that the operator who is having the hole drilled will support the driller by allowing him sufficient time to drill the well properly.

This fire may have been caused by slipping the line through the clamps.

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Troubles Caused by

Misalignment *of* Rotary Sprockets

IN recent times in the petroleum industry a much more scientific and much more careful attention and analysis has been given to the causes of breakdowns and delays in drilling and production operations. Operating officials, contractors and engineers have had the wholehearted support of the manufacturers of petroleum equipment in an effort to eliminate the causes of these annoying circumstances.

Rotary drilling has become the principal method of development and the increased depth of the oil-bearing formations has necessitated many changes in the weights and dimensions of the rotary tools. There has been one feature of the heavy rotary work which has caused much trouble, namely, rotary chain failures, and investigations of these failures have displayed some startling facts regarding misalignment of rotary drilling equipment.

With the manufacture of the heavier equipment, naturally came a much closer attention to finer machining of parts and every possible improvement of the machinery. When a rotary leaves the supply house yards for its first drilling location, it is as near perfect as possible. The alignment of sprockets from the engine to the line shaft, and from the line shaft to the drum shaft and the rotary table is usually perfect on the first well, but it has been noticed that on succeeding wells misalignment has often been permitted to creep into the rig. This might be termed the first and most important cause of rotary chain failures. Some instances of misalignment have been found where the sprockets have been eight inches out of line.

If the sprockets are not properly lined up, a tendency of side pull and strain is inevitable, and the result of this places the load carried by the chain on one side of the chain, instead of distributing it equally over all parts as intended. When such side pull and strain occurs, side bar and pin failures are common; whether the pin breaks and throws the entire load on the side bar, causing the side bar to break, or whether the side bar breaks first causing the load to be carried by the pin, causing pin failures is problematical. A more careful attention to sprocket alignment, and elimination of the conditions illustrated on the accompanying chart will be certain to result in a substantial reduction of rotary chain failures.

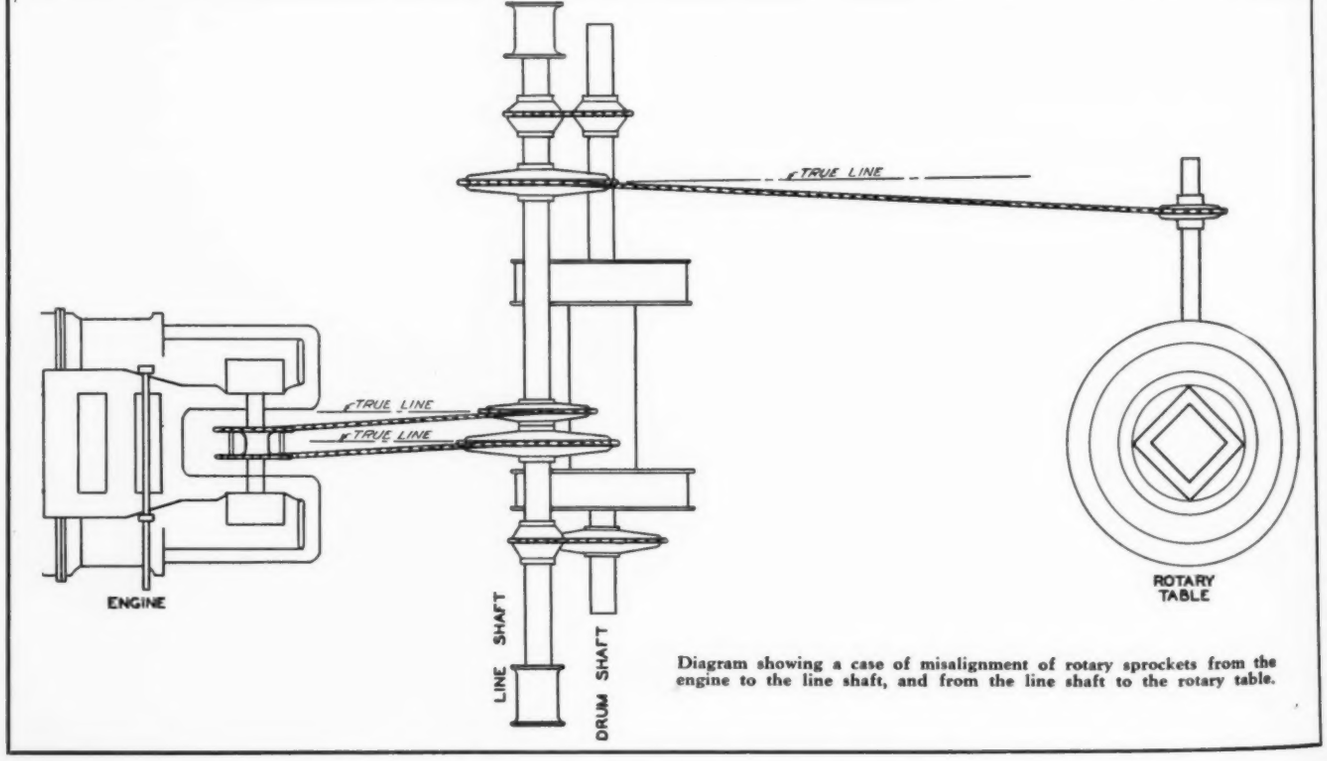
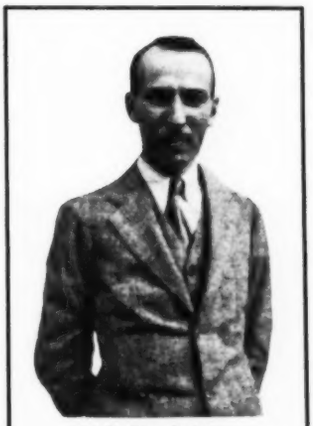


Diagram showing a case of misalignment of rotary sprockets from the engine to the line shaft, and from the line shaft to the rotary table.

Chemist Discusses Recovery of ICHTHYOL *from* CRUDE OILS

By E. W. ZUBLIN,
Chief Chemist, Texas Pacific Coal and Oil Co.

EVERY so often one hears about a certain new crude oil that is said to contain a large amount of ichthyol. Usually the owner of the well has a very vague idea of the properties of this peculiar product and all he knows about it is that it is a medical preparation made from certain types of petroleum oils and obtainable at the drug store at a high price. So it seems quite logical that the man who was fortunate enough to have a producing well dug in his backyard, should think that fortune would not stop at that, but that his oil should also contain large percentages of this valuable material, and soon he can't distinguish between wish and fact. The writer has had the opportunity to check on several such claims for ichthyol in crude oils and as was to be expected not a single one could be substantiated.



E. W. Zublin

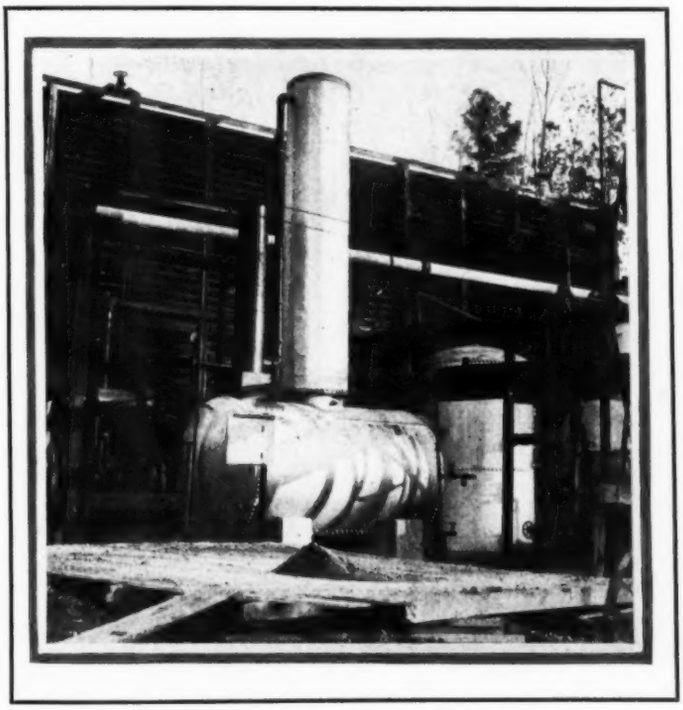
Before we try to find out what ichthyol actually is and how it is prepared, let us see what its applications are. It is used in the medical arts for antiseptic and antiparasitic purposes and if taken internally it increases the resorption and thus it is capable of curing certain intestinal diseases. Though it is quite widely applied in medical science, its annual consumption in the United States of America is hardly more than one thousand barrels. At the present time the prices are high enough to pay well for its manufacture because the supply of the crude material is limited. But suppose some one brings in a 100-barrel well containing, say, 30 per cent of components that can be used for ichthyol manufacture. The market would be flooded with this preparation, prices would drop and soon all manufacturers would operate at a loss, for the high standard of purity required of a medical preparation involves quite an outlay of equipment. To the writer's knowledge up to the present time ichthyol is manufactured entirely from shale oil.

To shortly review its history we have to go to Europe into the Bavarian and Austrian Alps. There in some places a black evil-smelling oil was found oozing from the rocks. People living in the neighborhood called them "stink stones". The curing effect of this oil was known in the middle ages and the famous Paracelsus Von Hohenbeim, the medical wizard of the 14th century, is supposed to have visited the places and made use of the oil. Here is a translation of a sample of a recipe which is said to be very old; it had been discovered at the home of a family of oil peddlers who had been engaged in this business for centuries:

"Strength, virtue and effect of the true and unfalsified Dursten Blood or Stone Oil, which is to be found on the Lakefield at the Harmel Pass in the royal county of Tyrol: First this oil is good against all poisons and people should use it in times of pestilence or when the Hungarian disease reigns, imbibed with soup and thus used. Also if a man has worms on his body, this oil smeared on it, will drive them off. And for the wild shots in the head take vinegar and that much stone oil mixed together, applied to the temple will cure it. Same for the toothache, one or two drops soaked in a wad of cotton and placed on the tooth, it will cure it. Also it quenches the heart burn and is good for all sicknesses."

Toward the end of the 19th century a German medical doctor, R. Schroter, began to experiment with this oil. He believed the sulphur in the oil to be responsible for its therapeutic properties, and consequently he tried to raise the sulphur content by treating the oil with sulphuric acid. This was the beginning of the ichthyol industry.

It was found that sulfonizing raised the medical effect of the oil tremendously and in a short time products were on the market that did no longer resemble physically the oil they were made from, but that had a superior therapeutic value.



The process of manufacture shortly reviewed is as follows: The shale, after being mined, is distilled in large iron retorts under vacuum. The distillate is treated with once to twice its own volume of concentrated or fuming sulphuric acid. The temperature rises from room temperature to above 200 degrees F. and large quantities of sulphur dioxide escape. After the reaction is finished enough water is added to dissolve the products of sulphonation, in order to separate them from the straight hydrocarbons and other substances that do not react. The sulphonated oil is then precipitated from the diluted sulphuric acid solution by means of an excess of concentrated sodium chloride

solution, drawn off and neutralized with very strong aqua ammonia to which at times anhydrous ammonia has been added. The finished neutralized product is a dark brown liquid containing about 50 per cent ammonium ichthyolate. It is completely soluble in water.

By the process of sulphonation two main types of compounds are formed: Sulfonic acids and sulfones: Their relative quantities depend on the amount and strength of sulfonic acid used as well as on the temperature of reaction. A good ichthyol must contain both compounds. The one that is therapeutically active is the sulfone. The sulfone as such, however, is not soluble in water. It has been known for a long time that such preparations if made water soluble become very much more active. The sulfonic acids or its ammonium salts are inactive, but soluble in water and have the valuable property of forming complex compounds with the sulfones which are also soluble in water.

Besides the sulfones and sulfonic acids there is a third group of compounds of undetermined composition, which also seem to have a certain medical value.

Ichthyol or its substitutes are marketed under various names. Most of those preparations are liquids, some of them come in form of powders. Following is a table with the analyses of some of them:

Name	Dry Content	Total Ammonia	Total Sulphur	Ammonium Sulphate	Chloride	Organic Dry Matter	Sulphur in Dry Matter	Sulfide Sulfur in Dry Matter
Ichthyol	55.7	3.16	10.72	5.94	.03	49.73	18.66	12.51
Ichthorate	53.5	3.53	8.25	6.60	.14	46.86	14.19	6.82
Ichthosane	53.9	2.74	8.24	1.69	.30	51.91	15.09	6.70
Isarol	54.3	2.82	8.67	2.76	.07	51.47	15.54	7.82
Lithyol	50.8	4.50	7.57	10.35	1.23	39.22	12.90	4.07
Piscarol	50.7	3.75	7.82	9.28	trace	41.42	13.44	7.27
Fossilol	51.9	3.15	8.57	5.65	.09	41.16	15.60	8.67
Subitol	47.9	3.33	8.05	7.63	.16	40.11	15.46	9.08
Trosnlfane	37.7	1.38	5.30	1.93	.....	.....	13.66	9.00

Ichthyol crude oils contain anywhere from 8 to 15 per cent of sulphur. The following table shows the sulphur content of four fractions of a typical ichthyol crude oil found in Southern France:

TABLE II

Boiling Range	Pressure	% Sulphur
284-302° F.	760 mm.	15
338-356° F.	760 mm.	14.3
320-356° F.	16 mm.	11.5
356-392° F.	16 mm.	11.4

As will be noted, the sulphur content is extremely high as compared with the sulphur in ordinary petroleum oils which commonly does not exceed 4 per cent. Considerable work has been done in Germany on the identification of these sulphur compounds. Scheibler[1] in his classical work isolated and identified a number of thiophene homologues. Usually other sulphur compounds are present, too, such as mercaptans, thio-ethers, hydrogen sulfide, etc. However, the compounds therapeutically active belong to the thio-phene group, or unsaturated thio-ether derivatives. It has been shown that the requirements for a good ichthyol crude oil are as follows:

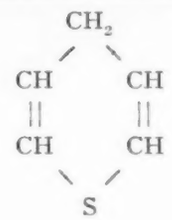
1. The sulphur content must be high.

2. The sulphur must be sulphidic, that is to say, it must not be oxidized, as indicated by the following formula:

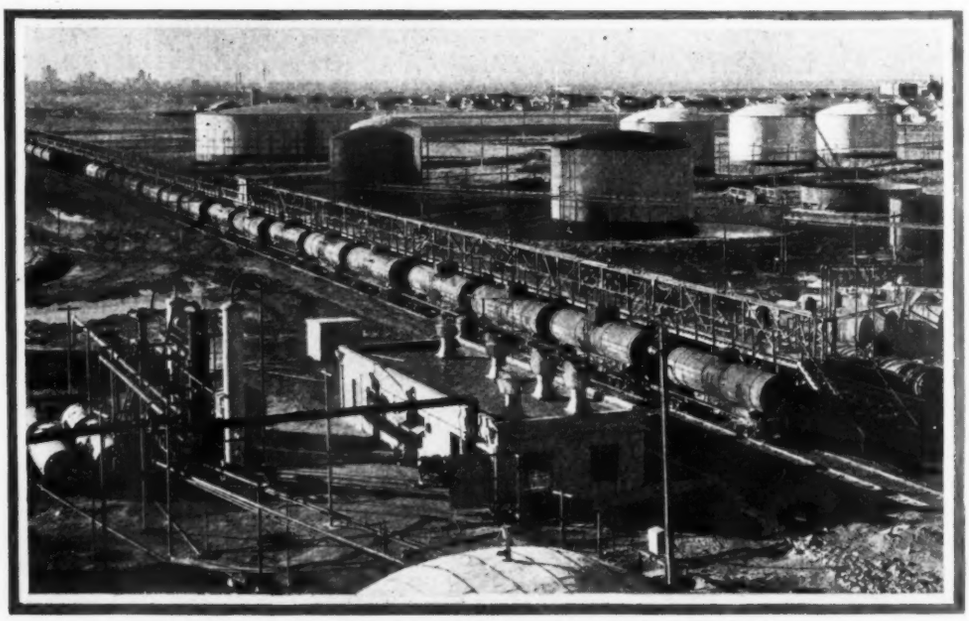
$$RC — S — CR$$

3. The sulphur-bearing compounds must be unsaturated, they must contain double bonds.

The types of compounds occurring most frequently and meeting these requirements are thiophenes. Other compounds such as the pen-thiophene



[1]H. Scheibler, Berichte 48 P. 1815: 49 P. 2595: 52 P. 1903: 53 P. 139.



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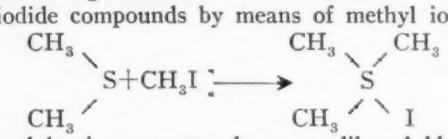
or unsaturated thio-ethers have also been found, but they are rather rare. It therefore may be stated safely that if a crude oil shall be tested for ichthyol, it must be examined for content of sulphur and thiophenen derivatives. It is peculiar that pure thiophene, if treated in the above described manner, is of no medical value whatever.

Thiophene and its homologues are usually identified by two reactions:

1. Laubenheimer's color reaction with phenanthrene quinone.
2. Precipitation with mercuric chloride.

Laubenheimer's reaction is carried out as follows: One drop of any distilled fraction of the oil is dissolved in a solution of phenanthrene quinone in an excess of glacial acetic acid. Cool in ice and add a drop of concentrated sulphuric acid. The appearance of a purple color indicates the presence of thiophene derivatives.

The precipitation method offers more difficulties because the oil has to be freed from thio-ethers previous to the test. Acid sulphur compounds and thio-ethers give also precipitates with mercuric chloride. Probably the easiest way of removing thio-ethers is to convert them into sulfonium iodide compounds by means of methyl iodide.



These sulphonium compounds are readily soluble in water, and therefore can be washed out. The reaction is carried out on a water bath; time of reaction 8 to 12 hours. The excess of methyl iodide can be removed with silver nitrate.

Acid compounds can be washed with a caustic solution.

After this preliminary treatment the thiophenes may be precipitated with mercuric chloride:

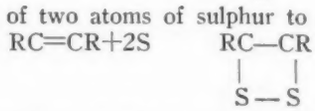
> 1 gr. of oil is dissolved in 40 gr. of alcohol. 37 gr. of a 10% solution of mercuric chloride in alcohol and 7.5 gr. of a 33% solution of sodium acetate are added. If a crystalline precipitation occurs within 24 hours thiophene or its homologues are present. The crystals can be filtered off, dried and weighed. Their approximate formula is
>
> (Thiophene)—H_g C12—H_g C10H

It must be stated at this point that thiophenes that carry side chains on the two alpha carbons will not produce any precipitate with mercuric chloride and in this case the color reaction is the only guide.

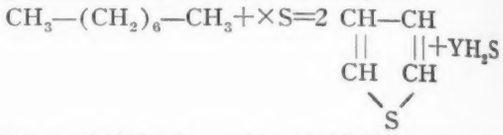
It has been tried at various times to introduce sulphur artificially into hydrocarbon by heating them with sulphur. Three types of reactions have been found to occur.[2]

1. Addition of a single atom of sulphur to a double bond in a hydrocarbon:

2. Addition of two atoms of sulphur to a double bond:



3. Ring formation of N-octane to thiophene



As will be noticed the formation of thiophene derivatives from petroleum oils by heating the latter with sulphur is only one of several types of reactions that may occur, and consequently the yield is rather low. Oils heated in such a manner can be and have been processed similarly to ichthyol crude oil, but the final product is very much inferior to real ichthyol.

The nearest substitute for ichthyol crude oil is probably a distillate obtained by running high sulphur asphalts to coke.

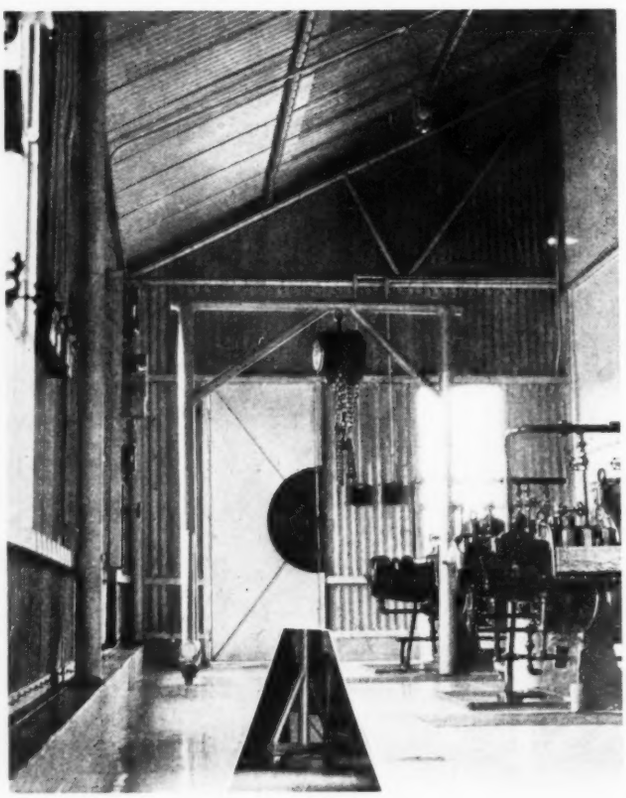
[2]Friedman, Berichte 49 P. 1344.

Portable Hoist *for* Centrifugal Stations

A PORTABLE hoist, of particular advantage in a centrifugal pump station, was designed by Barney Schmitz, division machinist of the Sinclair Pipe Line Company, to overcome lifting difficulties in the Maud station in the Seminole area. The hoisting frame was built with old pipe taken from the pipe yards, and is being used extensively.

One end of the portable hoist is equipped with rollers. The other end is designed so that the pipe fits over a swivel post set in concrete near the pump. When it is desired to work on any unit the swivel end of the frame is set over the post and will permit the frame to be swung around in any position except where it comes in contact with the fire wall.

In this manner parts of the pump are lifted off and lowered to a part of the floor



where they will be easy to work on, or out of the way of workmen while another part of the pump is being repaired or serviced.

The uprights on the ends are made with 3-inch pipe and the cross member is 2½-inch pipe welded to the uprights. The block is hooked to an eye welded on the bottom side of the cross member. At this point, where the greatest strain is put on the cross bar, it is braced with 2-inch pipe welded to the uprights and cross bar.

The rollers are inserted in a base made with 3-inch pipe welded to the main support on that end. This section is braced with 2-inch pipe as shown in the accompanying photograph. The device is painted to make it more attractive. When it is not in use it can be rolled to a part of the station where it will be out of the way.

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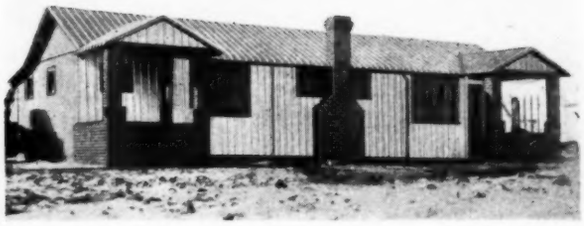

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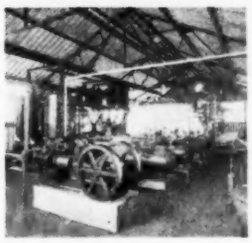

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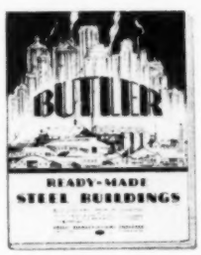

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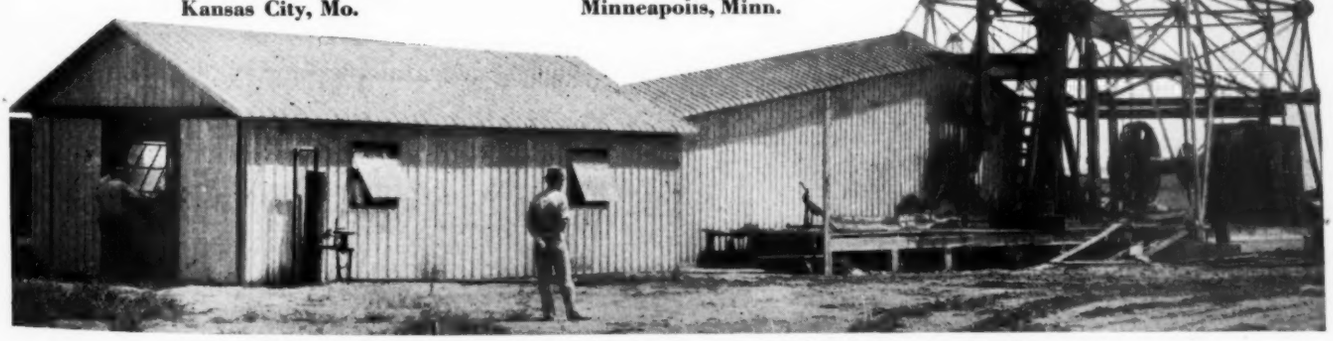

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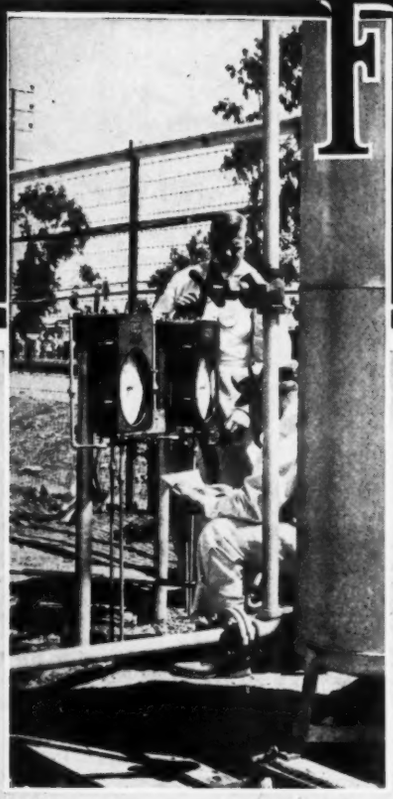

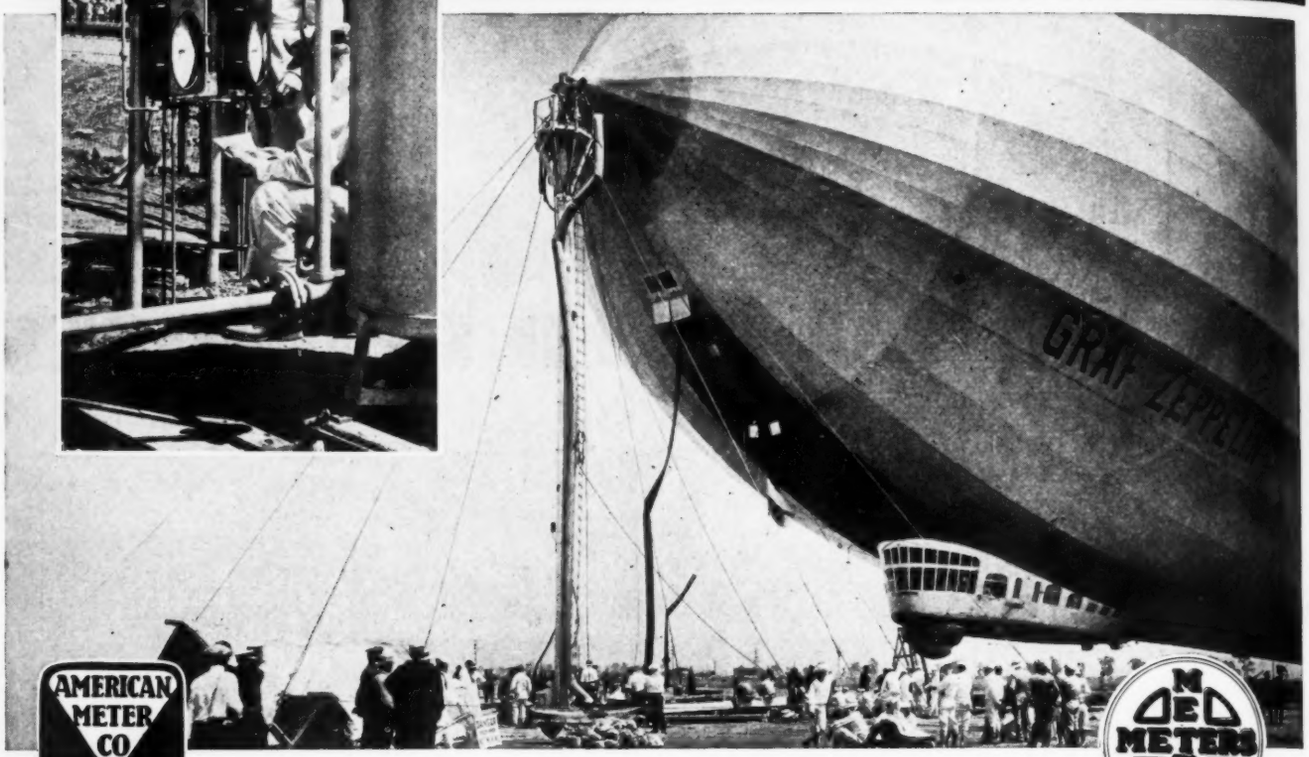

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Large photo above shows Graf Zeppelin taking on gas fuel at Los Angeles during round-the-world flight . . . Inset shows Westcott Orifice Meters used to insure accurate mixture of 36% natural gas and 64% Pyrofax.

METRIC METERS

ON her recent spectacular flight around the world, the Graf Zeppelin used gas fuel in her engines. Approximately 175,000 cubic feet of gas were taken aboard at Los Angeles, where refueling required about 12 hours. Throughout this period it was necessary to mix absolutely accurate proportions of natural gas and Pyrofax. Two 50-inch Westcott Orifice Meters were used to secure the exact control required.

Two Westcott Orifice Meters were used in a similar set-up for refueling at Tokio. This, the dramatic world-flight, furnishes further evidence of the part played by the products of American Meter Company in the industrial and technical achievements of the day.

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Ingenious Device Is

Sucker Rod Box Cleaner for Field Use

WHERE accurate service records are kept on equipment, it is found that mishandling in the field is a prolific source of trouble. This is especially the case where sucker rods are concerned. The fault does not, by any means, lie altogether with the field man. It usually can be attributed in large part to the lack of suitable equipment for handling and taking care of the rods on the well when they are being pulled. Rods, unless hung in some manner when pulled from the well, are bound to pick up a certain amount of dirt and gritty material. Even where the most elaborate precautions are taken to keep the rod joints clean, foreign matter will be picked up and adhere to the boxes and pins. Joints made up with such foreign material on the threads will not shoulder, and when run in the well in this condition sucker rod pin failure usually occurs, probably causing an expensive pulling or fishing job with its attendant troubles.

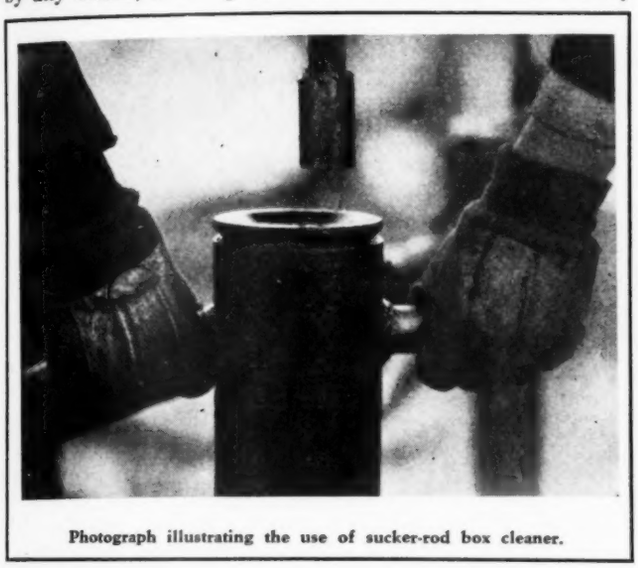
When the direct results of such failures are brought to the attention of the operator, and the loss shown in dollars and cents, it usually stirs the operator to action. The Gypsy Oil Company has gone a long way toward eliminating trouble caused from dirty sucker-rod joints. H. D. Collins, petroleum engineer with the Gypsy Oil Company, designed the sucker-rod box cleaner and the sucker-rod thread cleaner shown in Figs. 1 and 2. These pieces of equipment have been in successful use for some time on the properties of the Gypsy Oil Company in the Mid-Continent area. A description of the different parts of the cleaner as indicated by the letters on Fig. 1 is as follows:

A. The top which can be either screwed or welded into the shell (G).

B. Funnel-shaped rod box guide which is an integral part of top (A).

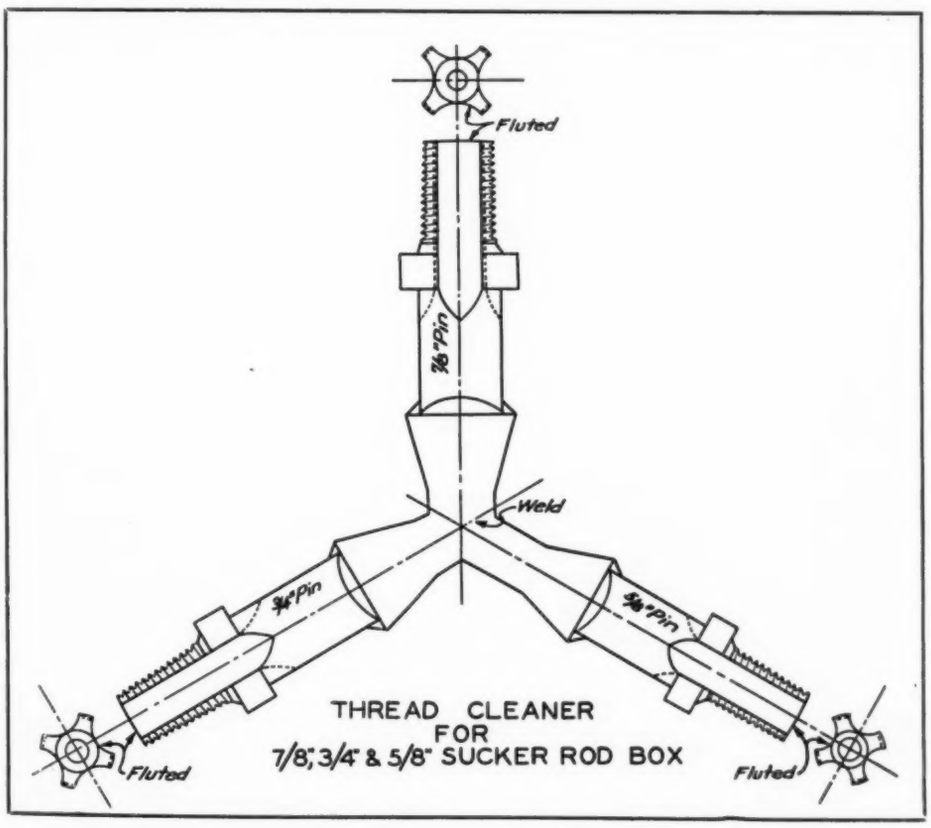
C. Perforated nozzle through which the cleaning fluid is sprayed when plunger (D) is forced down.

D. Hollow plunger which, when forced down, compresses the fluid, causing it to be sprayed out through the perforations in nozzle (C).



Photograph illustrating the use of sucker-rod box cleaner.

Photograph illustrating the use of thread cleaner for sucker-rod boxes.



E. Plunger cylinder which forms hydraulic chamber when ports (I) are closed by depressing plunger (D).

F. Compression spring which returns plunger (D) to its normal position after being depressed.

G. Outer shell or barrel of cleaner.

H. Fluid chamber which contains excess fluid and acts as settling space for dirt washed from boxes.

I. Ports to permit refilling of plunger cylinder.

J. Bottom of cleaner which can be welded or screwed on or made as a part of shell (G).

K. Flutes to permit sprayed fluid to drain away from box.

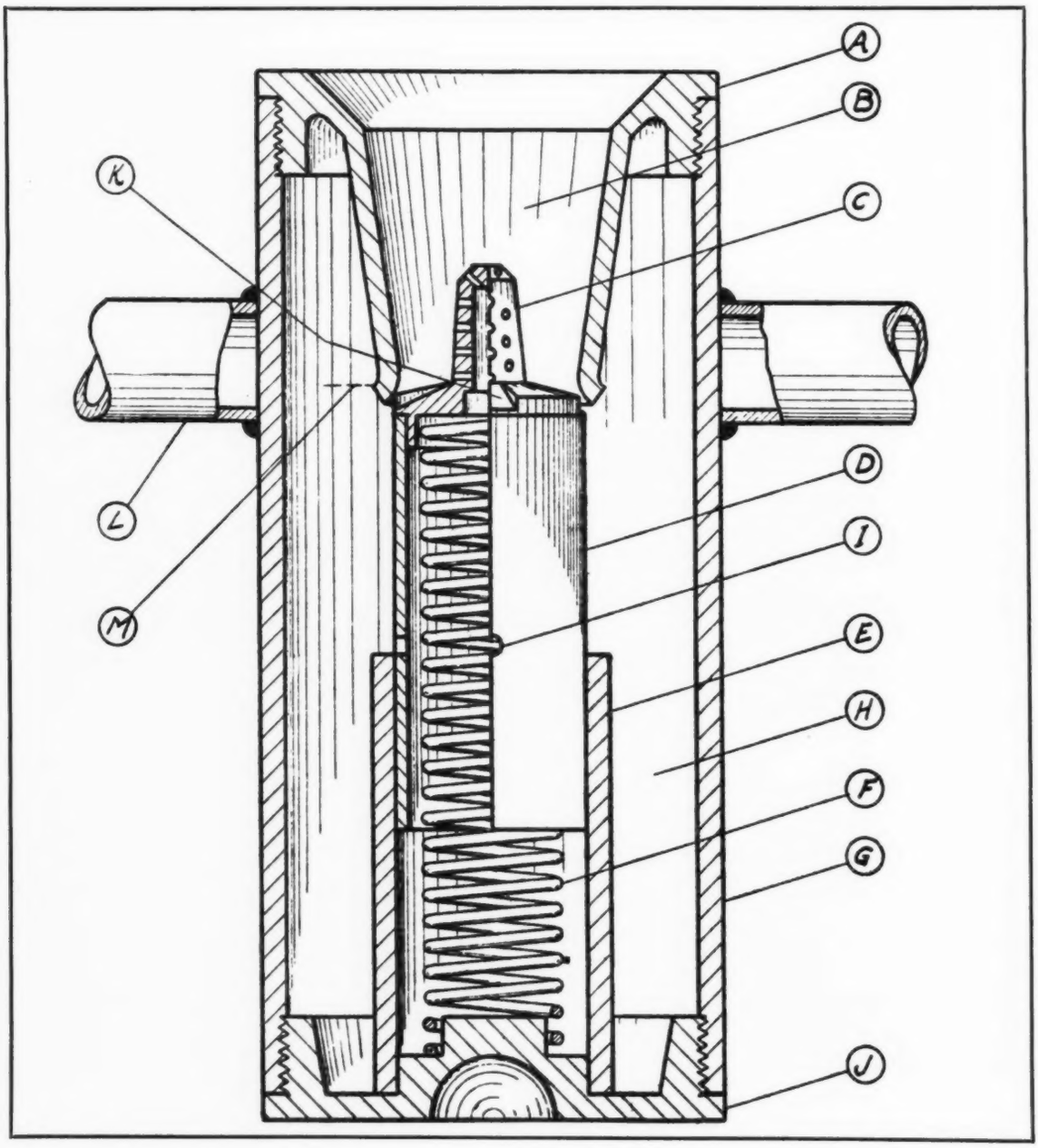
L. Handles.

M. Fluid level when in use.

The cleaner is about 4½ inches diameter by 10½ inches long and weighs approximately 8 pounds.

The box-cleaning operation is illustrated in the accompanying photographs taken while the cleaner was in actual use. With the rod hanging in the derrick, the box is

guided into the funnel or the cleaner and the cleaner raised and lowered against the rod. This movement depresses the plunger, causing the cleaning fluid to spray the inside of the box with considerable force, washing out all foreign matter. This operation is repeated two or three times to insure thorough cleaning.



Gasoline, kerosene, or any other good cleaning liquid can be used as a cleaning fluid. A stiff wire brush is used for cleaning the threads and shoulder on the pin end of the rod. All dirt and foreign matter thus is effectively removed from this end of the rod, and insures its properly making up.

In Fig: 2 is shown the combination tap or thread cleaner. The one shown can be used for ⅝-inch, ¾-inch or ⅞-inch joints.

Boxes, the threads of which have been slightly damaged or give trouble in making up, can be put in good order simply by running the tap into the box once.

How Material Is Reclaimed at

Prairie Pipe Line's Caney Shops

AN important and interesting phase of the successful operation of the Prairie Pipe Line Company's extensive oil transporting system is the shops and warehouse at Caney, Kansas, which are among the largest, if not the largest, in the oil country. At this plant almost everything required for the maintenance of a pipe line station may be obtained on short notice. If the part cannot be obtained from the stock room, there are not many cases where the shops cannot manufacture the desired piece of equipment. Little material finds its way to the junk pile, because when a piece of equipment is taken out of service in the field it is sent to Caney and when it finishes the rounds at the shops there is very little left to be thrown in the junk heap.

Probably the most difficult phase of operation of the Caney plant is the stocking of the warehouse. The shops require a large and diversified amount of material, and this, in addition to the material required along the pipe line, necessitates carrying and keeping up a complete stock of parts and equipment.

Operation of this important adjunct to the transporting system comes under the supervision of Carl E. Swank, superintendent, and a veteran in Prairie Pipe Line service. Because of the large inventory, the warehouse requires constant effort to keep it free of material that does not turn over rapidly. This is done by the warehouse foreman checking over his stock weekly and making a requisition for stock that has reached a minimum inventory.

When material is requisitioned the clerks in the warehouse note whether or not that material has reached its predetermined minimum. If it has, a memorandum is made of it on a special form. Weekly the warehouse foreman prepares a sheet showing material that is needed to keep the stock to a normal inventory. On the warehouseman's requisition he gives the present inventory of the stock, the turnover during the past six months, the maximum amount of material carried and other information, along with the amount he desires or thinks necessary to keep that particular material up to standard.

His requisition then goes to the accounting department of the Caney office. The inventory made by the warehouseman is checked against the ledger records of the accounting department. If the inventory and the ledger records check, the requisition for materials is started on its channels to the purchasing department.

The accounting department at Caney is a separate depart-

Upper left—Even this pile of junk will be picked over to see if it can be used. Upper right and lower center—Two carolads of old material sent to Caney from the field. Lower left—Small tanks and stands made at Caney shops. Lower right—A steel limb made in the shops.

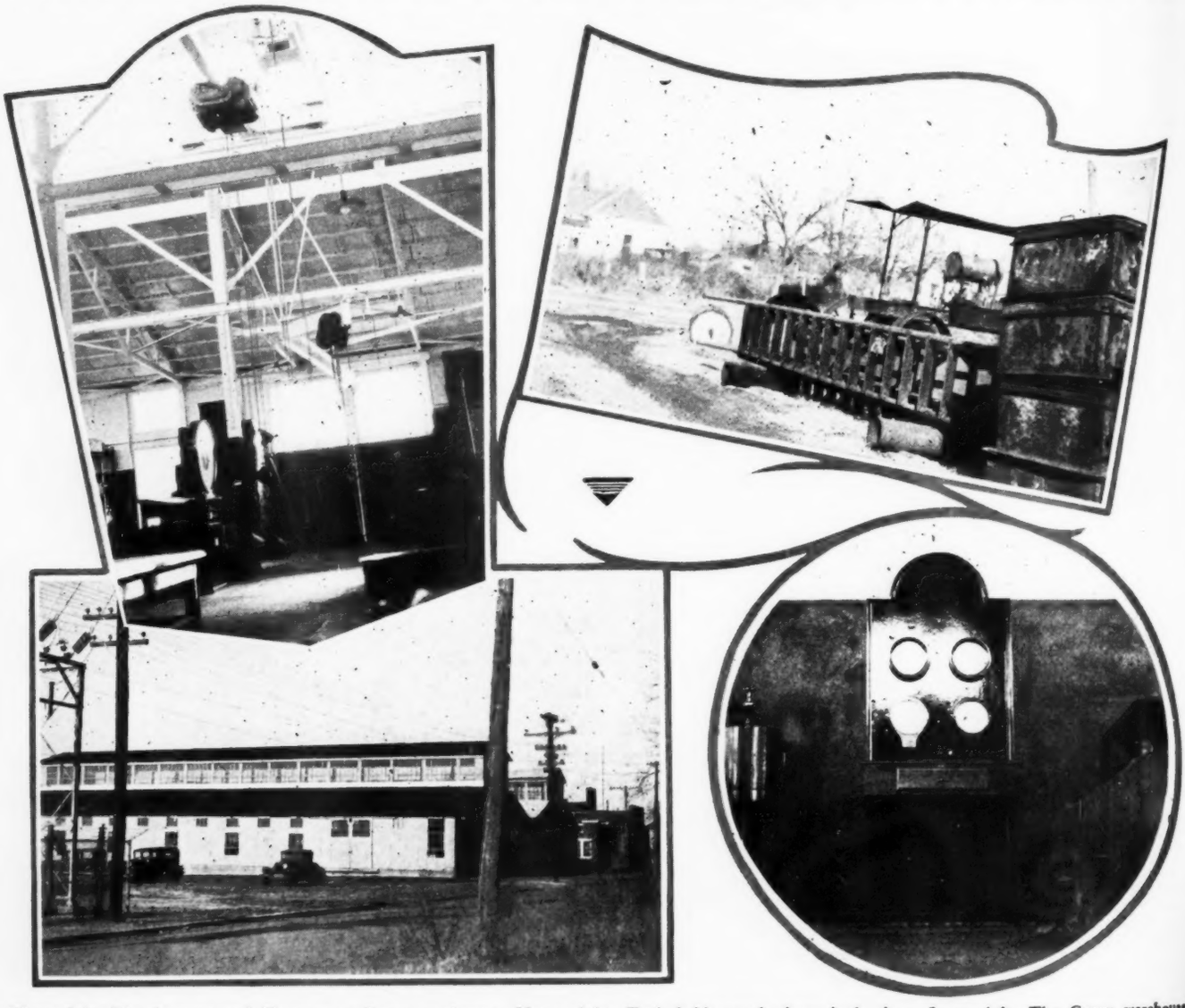
ment and permits that unit to be checked quickly at any time. It also affords showing the exact cost of any repair work done at the shops. Every item of material is tagged when it goes into the warehouse or is received into the yards. That tag shows the location of the material, the number of the section and its rack number, and the minimum amount of that stock carried. The same information is recorded on the ledger sheets in the accounting department. Whenever that stock is requisitioned all the necessary data is recorded on the tag and the ledger sheets. Three colors of tags are used, one color for each year, to aid in inventory work. Approximately 10,000 tags are used yearly and a complete inventory is made annually.

The method of storing parts and material is one of the most striking features of the plant, and has simplified handling of material as well as inventorying. All of the heavier parts are stored in the newer of the two buildings, which is equipped with a heavy-duty, electrically-operated traveling crane. With this crane heavy parts from that warehouse are lifted up and hauled to the automatic scales and lowered on them. After being crated and weighed the parts are moved by the jib crane and moved to the loading docks. In this manner the heavier parts are comparatively easily handled.

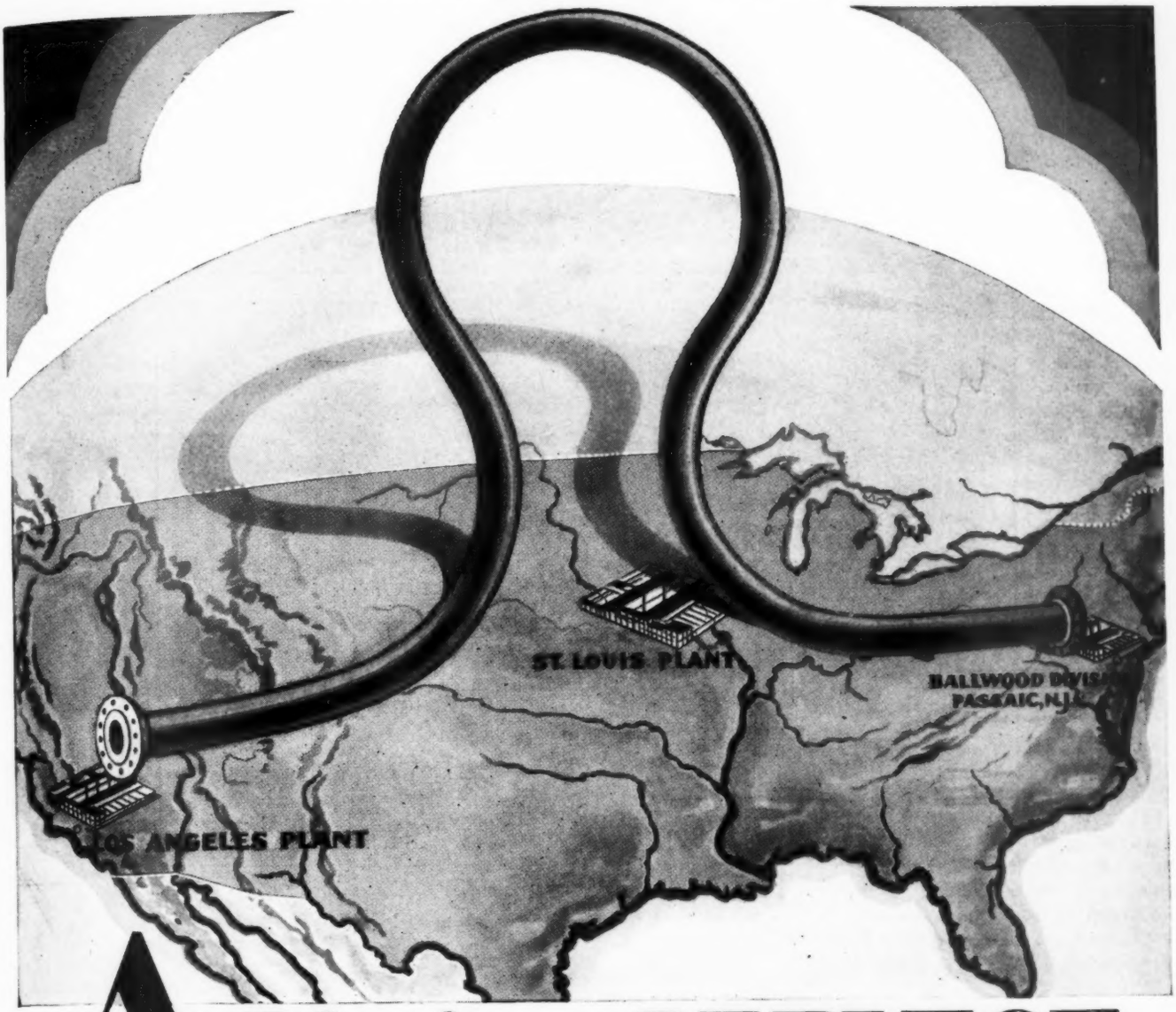
The nipple rack is one of the most attractive of the group of new racks, because of the ease it affords in getting stock, and, more important, in inventorying. The racks are built of frame and designed to hold twenty-five nipples in a row. Various sized racks are made for the various sized nipples, but all accommodate twenty-five nipples in a row. On one end the size of the nipple in that rack is stenciled and on the same end and parallel to the row of nipples are figures stenciled in multiples of twenty-five, so the complete rows of nipples are automatically counted. Thus, if eight rows of 2 by 6 nipples are in the rack, whoever checks that rack can look on the end and see that 200 nipples are in the rack.

The copper wire is stored in a sectional rack made of used pipe, and two of these racks hold one and one-half carloads of wire. When a shipment of this wire is received, the crane is used to fill the racks by first filling the lower section from the top and then placing the second section on top of the bottom section. In the same manner the third section is added and the rack completely filled. When the wire is to be shipped the electric crane is moved down to that section of the building, chain extended through as many rolls of wire as wanted and moved to the front of the building to be tagged for shipment.

Only the minimum of space is required for the storage of barreled material. Half a carload of insulators are stored in a rack 3 feet wide, 16 feet long, 8 feet high and made from old pipe. The rack is made in three sections and a platform that hooks on the end of any of the three



Upper left—Electric crane and jib crane at Caney warehouse. Upper right—Tank ladder made from junk pipe. Lower left—The Caney warehouse, office and machine shops. Lower right—Instrument board made in the carpenter shops.



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sections is used to load or unload the barrels.

Steel racks are also used to store the small gates and the rivet rack is made so that rivets may be retained in the kegs in which they are shipped, and when put in the rack they rest at a 45-degree angle. All of the small parts are kept in heavily screened partitions which are kept locked.

Another feature of the warehouse is the basement used for stocking rubber and composition material. It has been found that this type of material does not depreciate or deteriorate nearly so rapidly in the cellar where the temperature variation is not wide. The remainder of the thousands of parts required for the maintenance of pipe line stations are kept in the other buildings, and from the stock of the warehouse virtually everything for a pipe line station except the large engines and pumps may be obtained on short notice.

Skeleton of a shop-made building constructed at the Prairie Pipe Line Company's Caney shops.

The shops operated in connection can care for almost all of the transporting company's repair work and general shop requirements. This ties in closely with the engineering department maintained at the Caney warehouse.

Whenever a new station is being built some member of the engineering department at Caney makes a study of that station's requirements from a safety standpoint. He returns to the shops and draws the plans for the construction of belt guards, flywheel guards, the ventilating system, and so forth. These in turn are sent to the shops, where the construction is completed.

Quite frequently station engineers design some new safety device or a device to improve or cut operating costs at his station. His idea is explained to the engineering department, plans are drawn, and the device made in the shops. The shops include a wood-working department, which is equipped with some of the most modern equipment, including a universal wood-working machine where five men can work simultaneously. In this shop everything made of wood and used in the stations is constructed. Such things as doors, instrument boards, truck beds, cable boxes for telephone and telegraph lines, and general pipe line equipment, are turned out in the carpenter shop. In connection with this is a sheet metal department where much of the company's sheet metal work is done. All of the wooden doors are metal covered, and flywheel and belt guards and such equipment are built in this department.

In the welding shop, welders use both electric welding machines and gas torches to do welding for the company. This department is used extensively in turning otherwise junk material into some useful piece of equipment. Constructing small water and fuel oil tanks for the company pump stations from old tank bottoms is one of the specialties of the welding department. Numerous small size cone-bottom tanks have been built in the welding shop. The cone bottom is built from tank bottoms cut wedge-shaped and rolled, then welded together as illustrated in an accompanying photograph.

Very little of the material sent to Caney from the field as junk is actually sold as junk. Name whatever you will listed in the category of pipe line station equipment which it is practical to make in the shop, and somewhere along the line you will find a piece of that equipment in the Prairie stations which has been made in the Caney shops. Such things as stands for small lube oil tanks, steel ladders for tanks and many other devices which can be made from reclaimed material are built in the welding shops.

The welders are also used to construct the framework for many shop-made buildings. The building housing the shop in which they work was constructed from warehouse yard material. The steel framework for that building was made of old pipe. Eight-inch pipe was used for uprights, 3-inch for the rafters, 2-inch pipe for the braces and 6-inch pipe for the knees. All of the framework was welded and the sheet metal was fastened on with lead nails.

All of the company's small pumps and engines are shipped in to Caney when it is necessary to overhaul them. These, along with valves and fittings, are placed in a vat containing boiling chemicals, and cleaned. After being cleaned they are closely inspected. The pumps and engines are completely overhauled and placed in stock ready for service. The smaller fittings and valves are repaired, if possible, and placed in the warehouse.

The machine shop is one of the most complete of its kind in the Mid-Continent and only work on heavy parts, such as repairing crankshafts on 500-horsepower oil engines, has to be shipped to shops equipped with larger machinery. When necessary, engines and pumps are sent to the shops for overhauling and to be rebuilt.

Part of the shop's equipment includes two Babbitt furnaces, five lathe machines ranging from 16 inches to 30 inches, a five-foot radial drill and a high-speed nipple-making machine, and a complete line of pipe machinery.

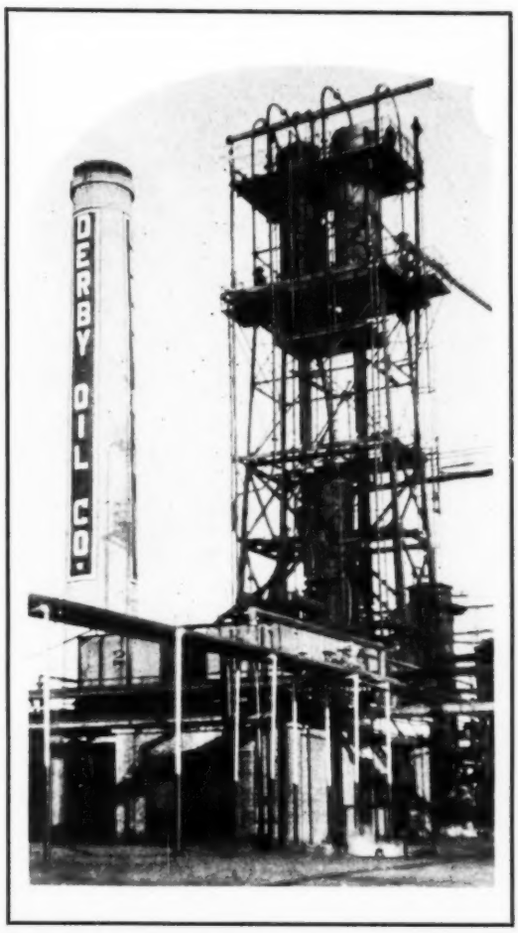
All of the old equipment used in line construction which has any salvage value at all eventually finds its way to Caney. It is dismantled, if it is worn beyond repair, and if the company owns several such machines, parts of the dismantled equipment are used to service the remaining machines. Some of the machines have been entirely torn down and parts of them used in rebuilding a machine of similar type.

Derby Oil Co. Refinery Obtains Excellent Results with

Flow and Liquid Level Controls

THE Dubbs Cracking Units, used in the manufacture of "Derby Unvarying Dependability" gasoline at the Derby Oil and Refining Corporation, Wichita, Kansas, are equipped with flow and liquid level control instruments, resulting in a remarkably smooth operation and uniform quality gasoline.

Two control instruments are installed on a unit. A flow controller is located on the hot oil line to the top of the dephlegmator tower. A 1½-inch control valve with a steel body, stainless iron trim lubricator is located directly in the hot oil line. The temperature of this oil is approximately 275 degrees F. The liquid level control instrument controls a 1-inch bronze valve located in the steam line to the hot oil surge pump. The differential connections are made in the dephlegmator leg. The high pressure tap is located in the keg at the bottom of the tower and the low pressure tap is located approximately 100 inches below.



Flow Control

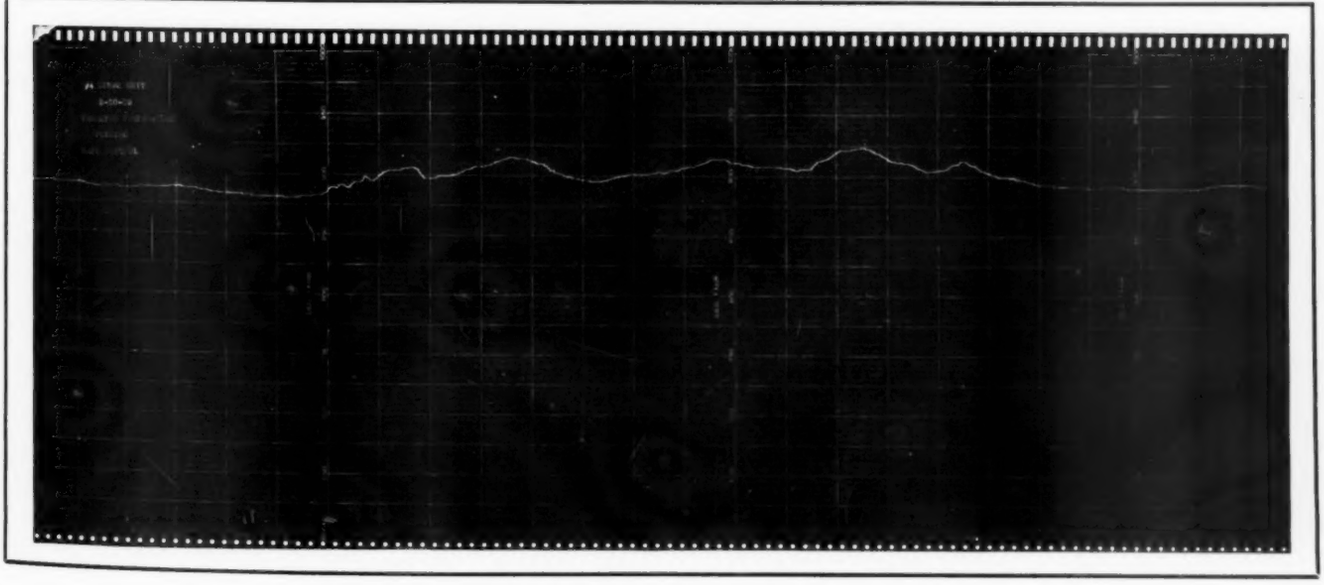
The flow controller operation is based upon the principle that if an orifice is placed in a line of flow, having a diameter less than that of the line, a greater velocity will result at the orifice. A drop in pressure on the downstream side of the orifice plate results, and this drop is directly related to the rate of flow. It is only necessary to control this differential pressure in order to control the rate of flow of noncompressible fluids. The control valve action is based upon the principle of floating action control which permits the flow control to hold the controlled valve stationary at the correct opening or to change its opening to counteract any change in the process.

The improvement in operation by the use of control instruments over the manual control method is shown by the charts:

Chart No. 1 is a record of the flow of the hot oil to the dephlegmator tower prior to the installation of the liquid level controller. The chart range is 0-10 direct reading and shows a variation in flow of approximately 73 per cent.

Chart No. 2 is a record of the liquid level of the hot oil using hand control. The chart has a range from 0 to 25 pounds, which is equivalent to from 0 to 73 feet of hot oil. This record shows a variation in level of approximately 27 feet.

Chart No. 3 is a record of the flow to the top of the dephlegmator tower with the flow controller installed on the hot feed to the tower. This is direct reading chart 0-2000 gallons per hour. The normal charging rate to this unit is 1200 gallons per hour.



CERTAIN TO COME . . .

Complete Elimination of Expanded Tubes

Many authorities are repeating this statement, and refiners welcome the Stockham Fantz-Type Return Bend as a solution to the gravest cracking still problem of today.

The Stockham Fantz-Type Return Bend

Is quickly and easily assembled.

Is positive streamline flow.

Is easily dismantled for cleaning—no bolts to stick—thereby eliminating unnecessary delay in down time.

Permits replacement of single tubes without damage to adjacent tubes.

Is economical because of ready replacement of U-Piece at nominal cost, this being the only part of the assembly in contact with corrosive elements and therefore the only part necessary to replace.

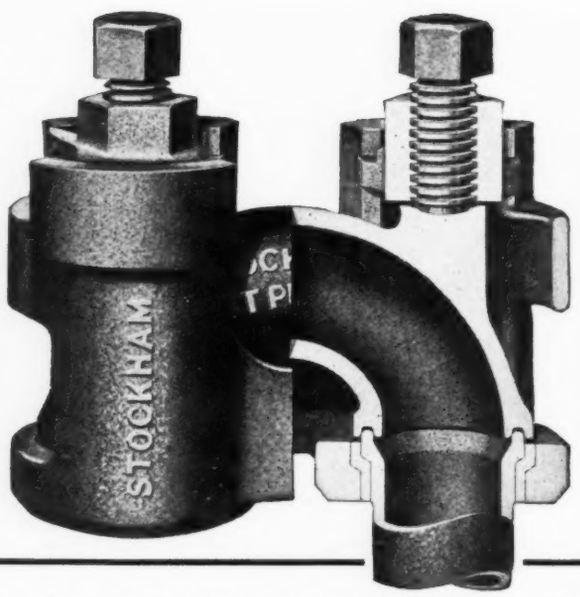
Our petroleum division will gladly furnish additional information.

See us at the Oil Equipment & Engineering Exposition
In Los Angeles, March 16-23, 1930.

STOCKHAM PIPE & FITTINGS COMPANY, BIRMINGHAM, ALABAMA

STOCKHAM
(FANTZ-TYPE)
RETURN BEND

Patents applied for in the United States and in Argentina, Canada, Colombia, Dutch East Indies, England, France, Germany, Holland, India, Italy, Japan, Mexico, Persia, Peru, Poland, Rumania, Trinidad, Venezuela, Australia, Dutch West Indies and Cuba.



STOCKHAM FITTINGS

THERE IS A STOCKHAM FITTING FOR EVERY OIL REQUIREMENT
ELECTRIC CAST STEEL
MALLEABLE
CAST IRON

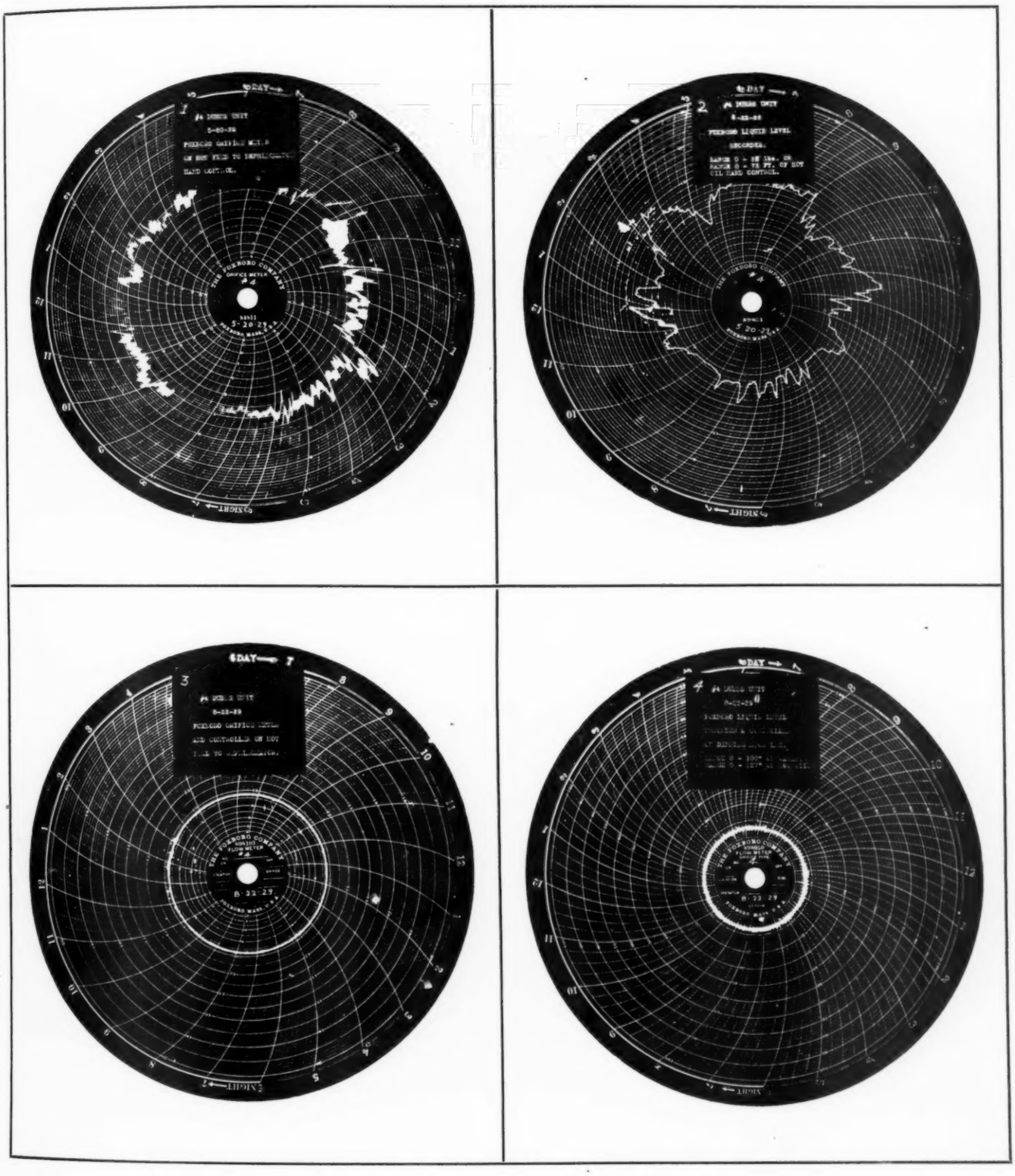
When writing STOCKHAM PIPE & FITTINGS CO. *please mention The Petroleum Engineer*

Chart No. 4 is a record in inches of water of the level in the dephlegmator leg with the liquid level controller controlling the feed of the hot oil surge pump and indicates the maximum variation of 2 inches.

Chart No. 5 is a temperature record on the pyrometer of the transfer temperature, that is, the temperature of the oil leaving the pipe still. This is a record prior to the installation of the controllers and indicates the variation of vapor temperatures of over 125 degrees F. (See Chart No. 7.)

Chart No. 6 is a record on the pyrometer of the transfer temperature after the liquid level and flow controllers were installed.

Chart No. 8 is a record on the pyrometer of the dephlegmator vapor temperature after the controllers were installed. This showed a very decided improvement over hand-control and a variation for the most part of only 20 degrees, with the exception of one unusual upset of 50 degrees. This variation should be compared with the variations of the 125 degrees as recorded on Chart No. 7. This is exceptionally good temperature control, since the reflux is controlled by hand and there is not a temperature controller on the unit.



IDECO

DO you want known strength yet lightness? IDECO gives it. Portability? IDECO gives it. Speed of erection and disassembly? IDECO gives it. Absence of maintenance expense? IDECO gives it. A derrick practical in every respect to work under? IDECO gives it. Genuine economy? You have it in IDECO galvanized structural steel derricks.
IDECO
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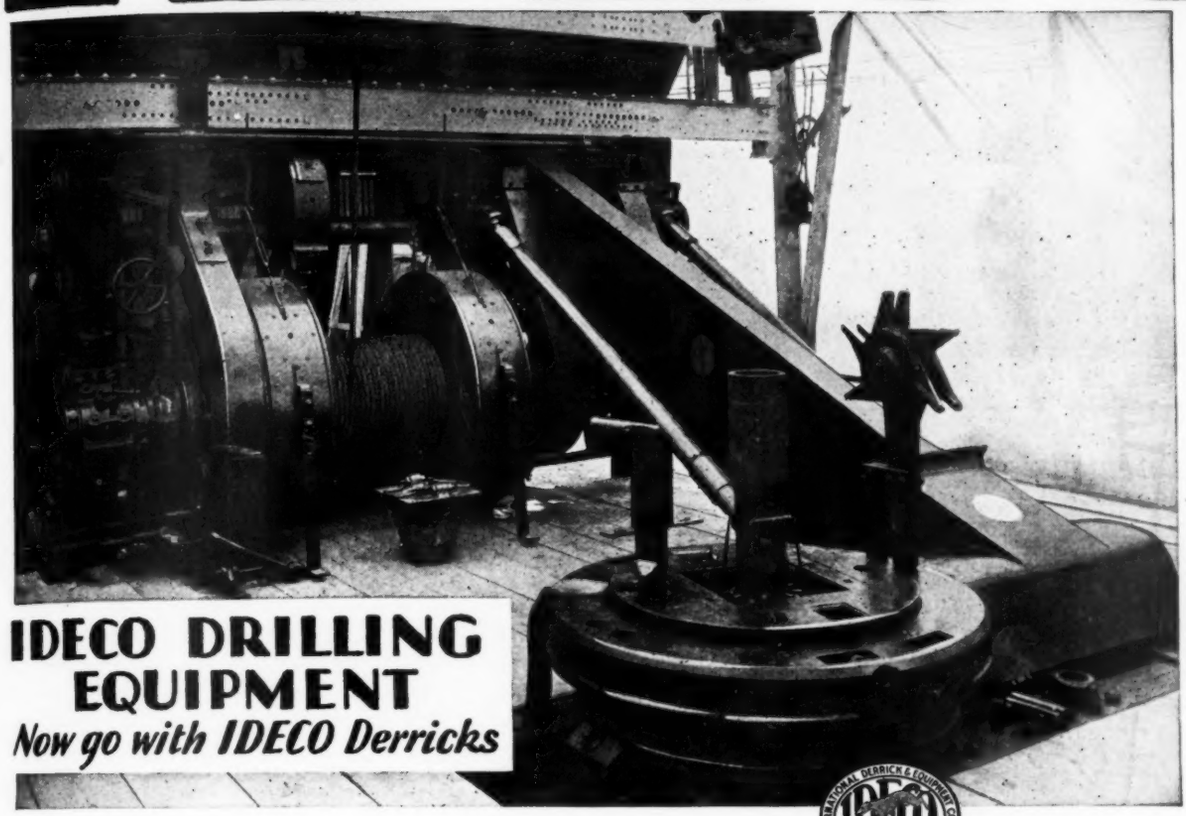

IDECO DRILLING EQUIPMENT
Now go with IDECO Derricks

The IDECO Boykin Greyhound line of Rotary drilling equipment affords the producer exactly what he needs to complete his IDECO Derrick. A Rotary Draw Works with all manner of strength, simplicity and efficiency. A new 27-inch Make and Break Rotary equipped with roller bearings and affording greater speed, smoother operation and complete control. Straight Line Roller Bearing Crown and Traveling Blocks, faster, carrying more weight and easier on the lines.

These products and many others of IDECO are fitting mates to the superb towers above. They insure the permanence of your investment on one location or many.

IDECO-BOYKIN PRODUCTS

Derricks	Reduction Gear Units
Bull Wheels	Chain Driven Rigs
Calf Wheels	Machinery Supports
Band Wheels	Tubing Hoists
Counter Balances	Rotaries
Walking Beams	Countershafts
Pitmans	Traveling Blocks
Sand Reels	Crown Blocks
Draw Works	Tubing Catchers
Draw Work Braces	Standard Steel Buildings

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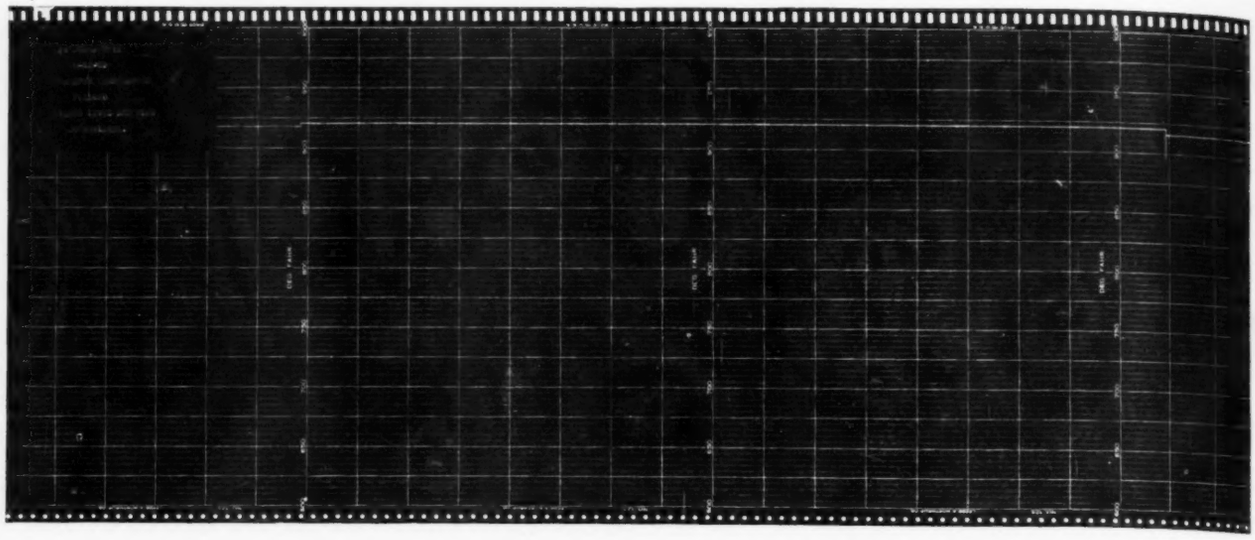
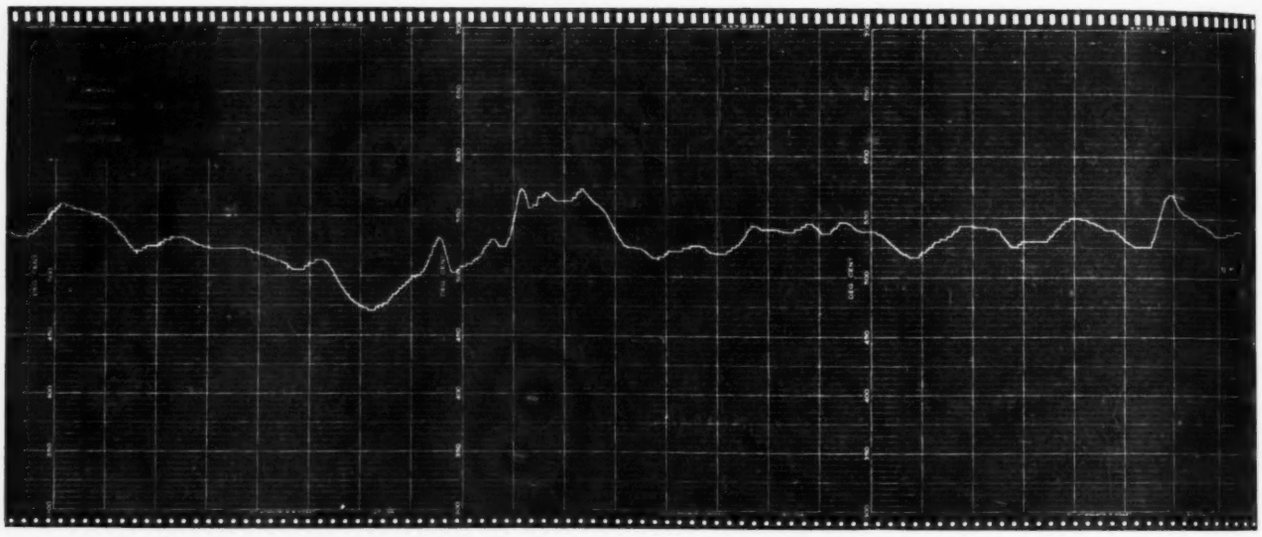
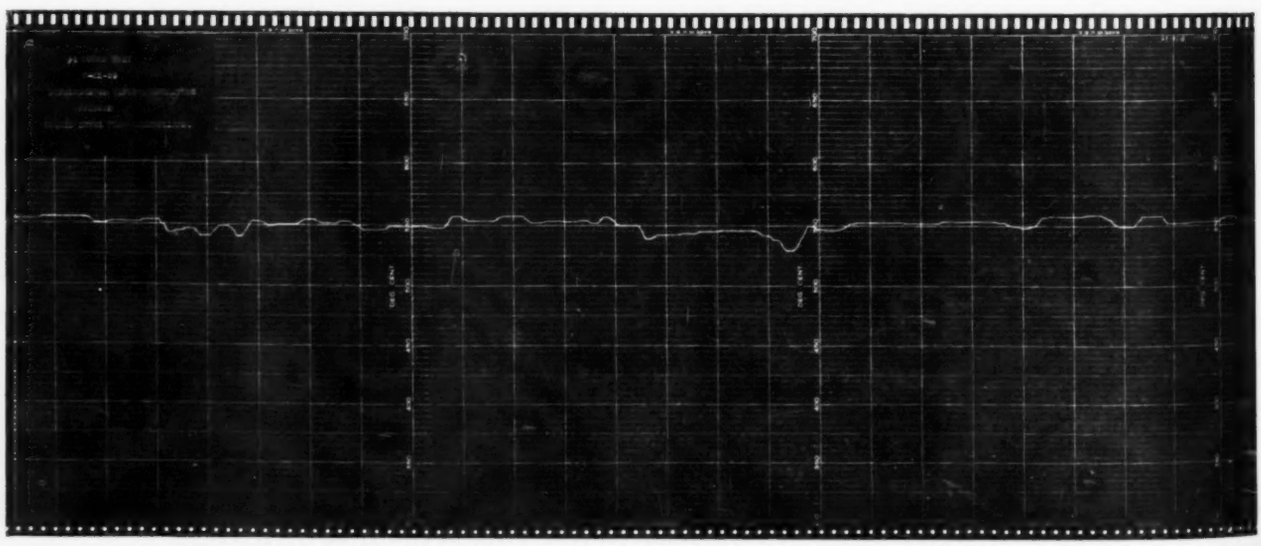
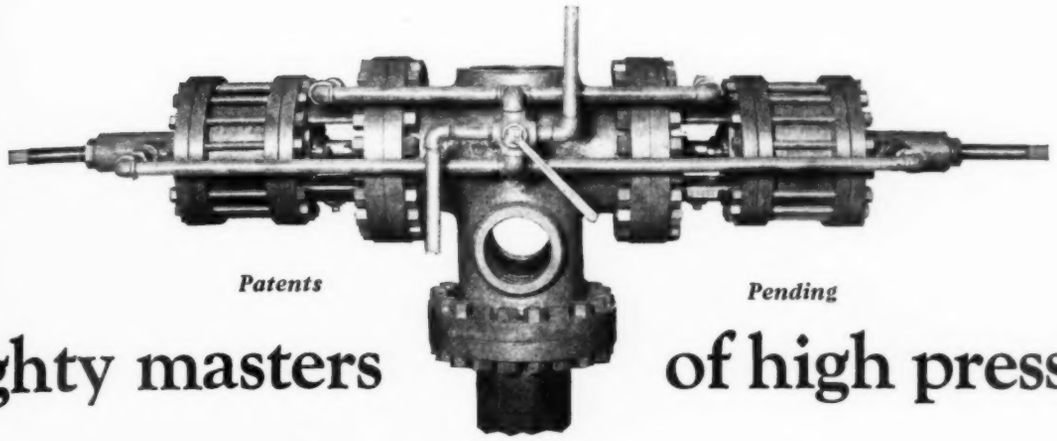


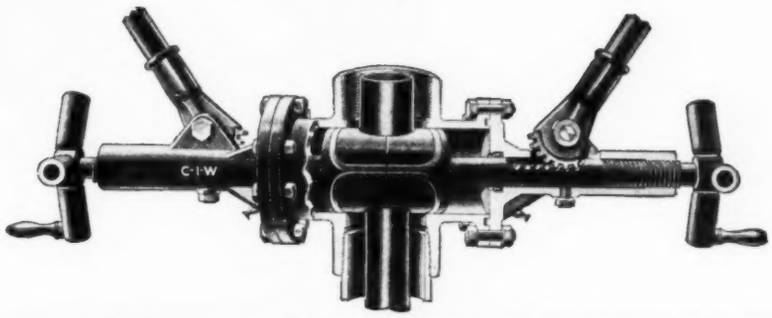






Patents *Pending*

mighty masters of high pressures



by CAMERON IRON WORKS

Steam Operated Blowout Preventer

These very important features are to be found in the CIW Steam Operated Preventer and their presence accounts for it being the most outstanding preventer in the field today.

REMOTE CONTROL: Allows the well to be closed with absolute safety. None of the crew has to go near the derrick.

INSTANTANEOUS: Quarter turn of four-way valve securely locks the steel rams around drill stem.

POSITIVE GRIP: Solid steel rams, packed with hydraulic rubber, take a vise-like hold on drill stem or casing. When closed rams form complete circle of steel through which couplings cannot pass.

EASY INSTALLATION: Flanged connection to last string of casing. Flanges made in reducing sizes to fit A. P. I. casing from 6⅝" to 16" outside diameter.

GUARANTEED: All preventers are tested and guaranteed to withstand 3,000 pounds pressure.

Los Angeles, March 16-23, 1930

6,000 lbs. Test Tubing Control Head

This new, heavy duty Tubing Control Head makes it possible to run tubing under the heaviest pressures without killing the well.

The control head operates by means of two heavy steel rams, with concave faces, that are packed with a special hydraulic rubber packing. When closed these rams form a complete circle of steel around the tubing, thus holding the tubing and sealing in the pressure. The rams are operated by means of lever-jacks and lock-screws which furnish two means of closing the control head. Each tubing control head is tested and guaranteed to withstand 6,000 pounds pressure per square inch.

By using two of these heads, one above the other and opening and closing them alternately to allow couplings to pass, it is possible to snub in tubing against any pressure without killing the well.

For low pressures there is the 1,200-pound test tubing control head which has been extensively used for "tubing" wells developing less pressure than 1,200 pounds per square inch.

CAMERON IRON WORKS INC.

HOUSTON TEXAS

California Distributor *2800 S. Alameda St.*

PETROLEUM EQUIPMENT CO. . . . . Los Angeles, California

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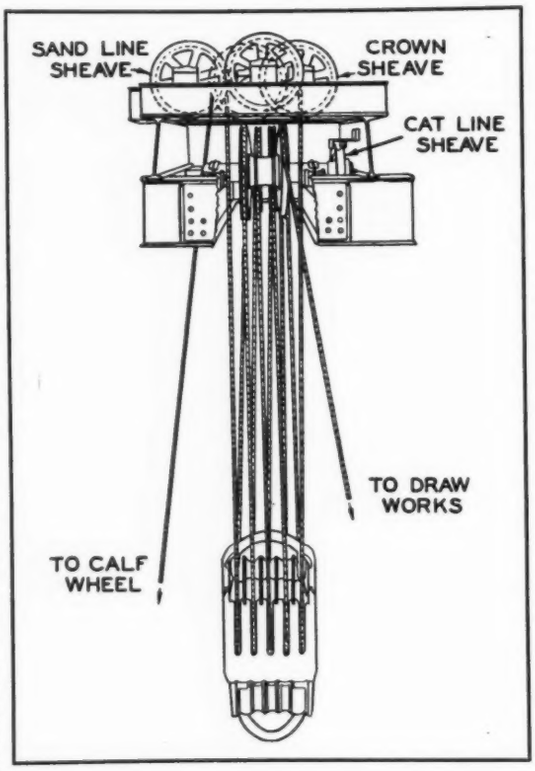
Wire Line Life May Be Lengthened *by* Careful Use

THERE are very few items of petroleum equipment which have been permitted to stand more abuse than the oil field wire line. Regardless of whether the drilling was of the cable tool or rotary variety, the strains to which wire lines were subjected and the lack of care which marked their oil field service were sufficient to make one wonder that a line was capable of withstanding service on a single well.

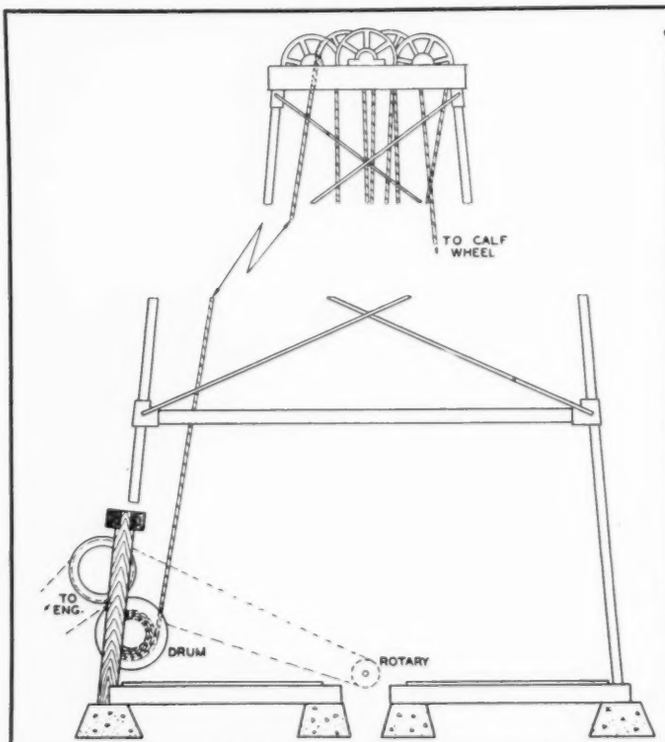
From the time when an oil field "skinner" drove up to the rig and dumped the spool containing the wire line off, regardless of how or where it landed, the life of the lines were hard. In unloading, the lines were simply dumped off, and if they chanced to land on a portion of the ground which was covered with moisture it made little difference.

The next step was in their unspooling. Up to a very few years ago, wooden horses were seldom utilized for transferring the lines from the drums which originally contained them to the bull wheel shaft. The ordinary process was to throw the drum on its side, fasten a light block to any convenient part of the derrick, and start the engine, dragging the line over the crown block and onto the shaft. Wire rope lubrication was a thing unknown.

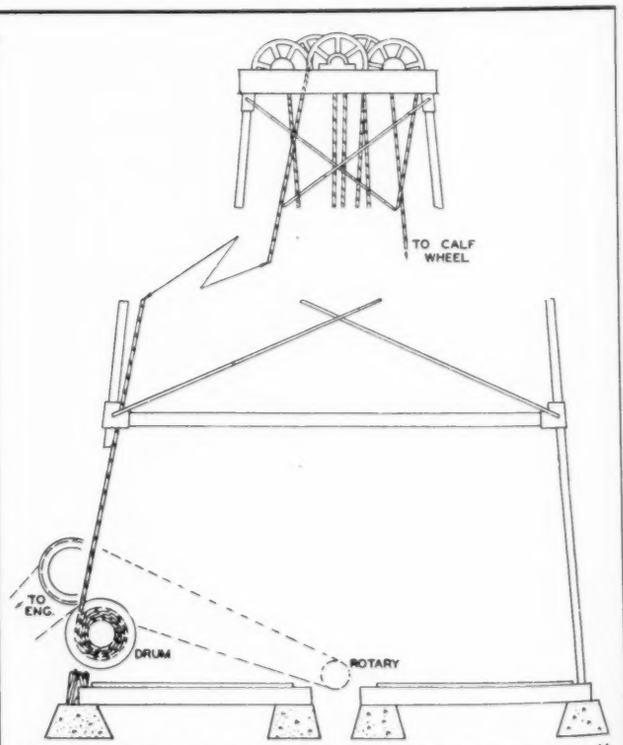


Little attention has been paid to the diameter of wire lines with respect to the diameter of the objects such as shafts or sheaves over which they must pass. In this connection the petroleum industry might profitably observe the mining industries which have set rules regarding diameters. In coal mining work the diameter of a shaft or sheave must be 48 times the diameter of the line passing around or over it.

The numerous bends and reverse bends which mark the workings of the wire line in oil field service form another obstacle in the path of improved line service. This matter is also contrary to the practices used by the mining and many other industries which are large users of wire line. Under the present conditions of rotary service a wire line leaves the drum on the inside of the derrick floor. It passes upward to the crown block and then, making a reverse bend, travels downward. From a point of wire line service it would be an improvement if this reverse bend could be eliminated and the path of the line become continuous.



Sketch showing present relation of rotary line to crown block; in this arrangement the line leaves the drum and makes a reverse bend in going over the crown block.



Sketch illustrating how, from a rope standpoint, improvement would be made were it possible for the rotary line to leave the drum from the rear, traveling over the crown block and eliminating the reverse bend.

Development and Use of Curves for . . .

Studying Operation of Pumping Wells

By A. L. FABER

The application of power to oil-well beam pumping is a very difficult problem, primarily because the power using equipment, namely, the working barrel, may be anywhere from one-fifth to one and one-half miles from the source of power. A study of the power measurements will give an indication of the causes and suggest a solution of the problems encountered in oil well pumping. Eventually empirical formulae can be developed.

The power input curves should be run by an instrument fast enough to get the story and it has been found that for field use the 12-inch-per-minute graphic watt-meter serves this purpose admirably.

It is believed that the evaluation of the factors that go to make up oil well operating conditions should be made with reference to the power input curve, because it can be obtained accurately, quickly, and at a minimum expense. We then arrive at the point where the setting up of a so-called perfect well for each sand would seem to be the logical step. This would give a definite reference point for the operation of all wells producing from that sand in the area. The "perfect well" can be arrived at by running curves on a number of wells, studying their operating characteristics, and then picking out the one which gives the best overall results. The type and weight of counterbalance, size of tubing, rods, size of lead line, type of working barrel, size of valves, and length of valve cages particularly should be studied. Enough time should be given the well to operate to develop the fact that a minimum of operating troubles are encountered before the so-called perfect or standing well is set up.

The power curve shown in Fig. 1 is that of a reference well for second-sand wells in Smackover field. It will be noted that a walking beam curve was obtained and superimposed on the power curve. The walking beam curve was

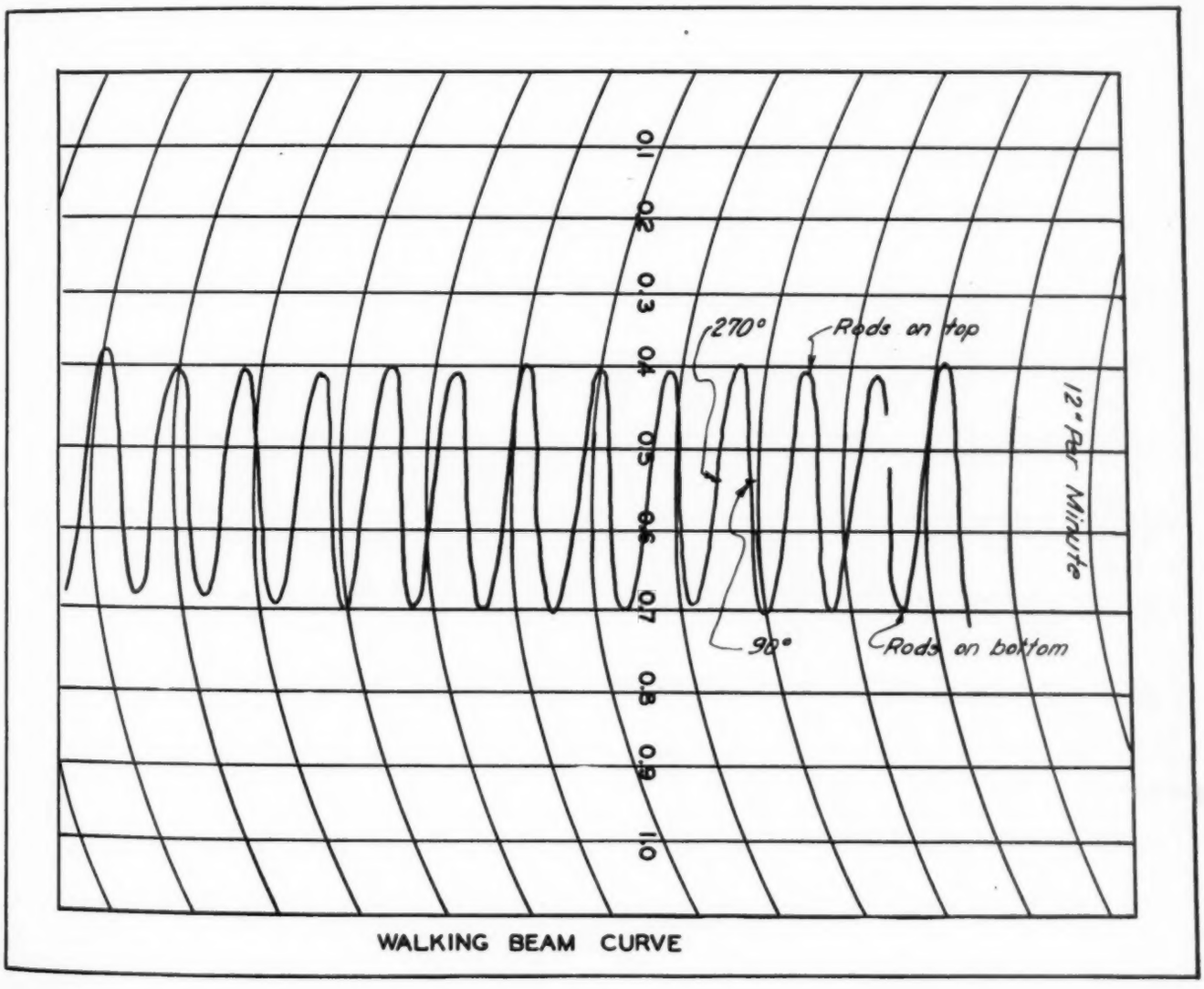


Fig. 1

obtained by attaching a string to the walking beam, linking it so that vertical motion was transferred to horizontal motion, as shown in Fig. 2. The string was attached to a stake behind the motor house with enough tension to take up the stretch. By attaching a pen to the string the curve shown in Fig. 3 was obtained with a chart running at 12 inches per minute. During the taking of the curve the position of the power indicating pen was noted at top and bottom of the stroke and exact results recorded.

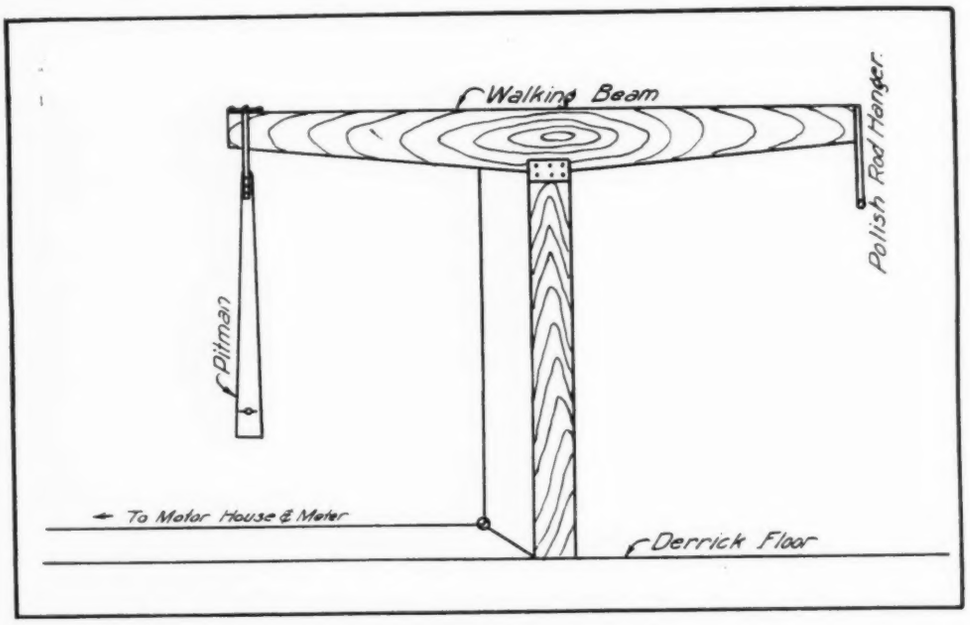


Fig. 2

It will be noted that on the well studied, the point of maximum power input seems to come between five and six o'clock on the crank circle, the crank rotating clock-wise. The method used, naturally has some inaccuracies, but the hook-up is simple. Data concerning the amount of error will be given in a later article. By following this method the counterbalance can be checked and the rate of change of stress on the pumping system be made a minimum.

Rod fatigue and rig troubles are proportional to the maximum stress, and the rate of change of stress, presupposing that normal operating conditions are present.

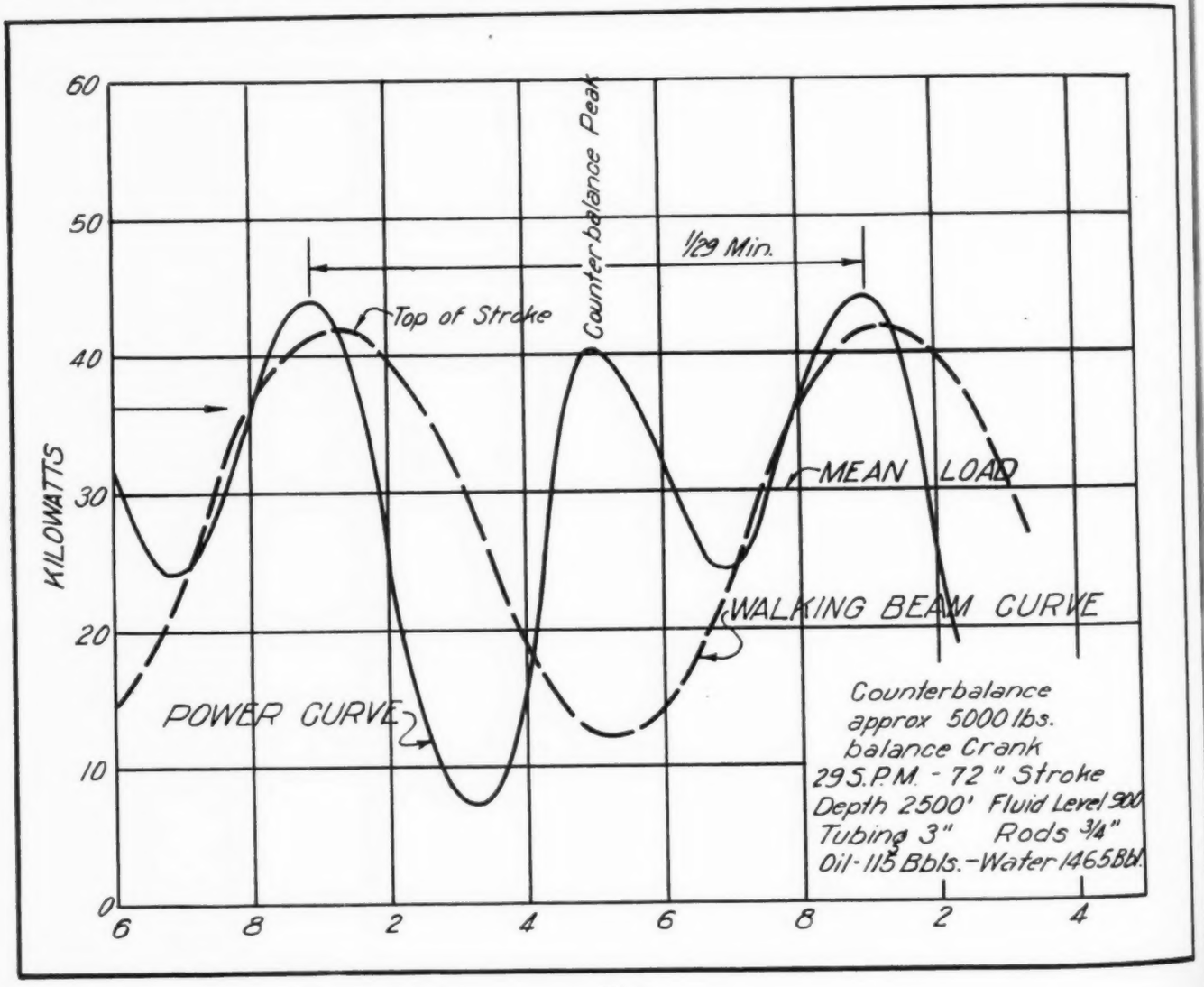


Fig. 3

TALK NUMBER TWO BY A PROMINENT DISTRIBUTOR

"Rent— Heat—Light—Insurance

Expenses You Need Not Pay

REPUBLIC SUPPLY CO.
THESE ARE TYPICAL OF 25 OTHER REPUBLIC SUPPLY COMPANY STORES
REPUBLIC SUPPLY CO.
GUMBO BUSTER MACHINERY

Above—Mr. J. H. Brooks, Vice President of the Republic Supply Company of Houston, Texas. This company's services are of a definite economic value to the prosperity of its business territory.

WE can save any consumer of industrial supplies, warehouse expense, which means—rent—heat—light—and insurance.

To be able to make that statement means we must investigate exhaustively all competing sources of supply who make the merchandise we handle. We recommend Republic's Belting — Hose — Packing — Molded and Lathe Cut Goods."

The above statement is characteristic of those made by prominent distributors all over the country. It explains in part how the Industrial Supply Distributor, helping to solve the important problem of broad markets and *economical* distribution, upholds high quality, maintains fair prices and saves needless efforts on the part of both consumer and manufacturer.

There is a difference in fire and mill hose regardless of specifications as is well known by thousands of users of Republic Hose.

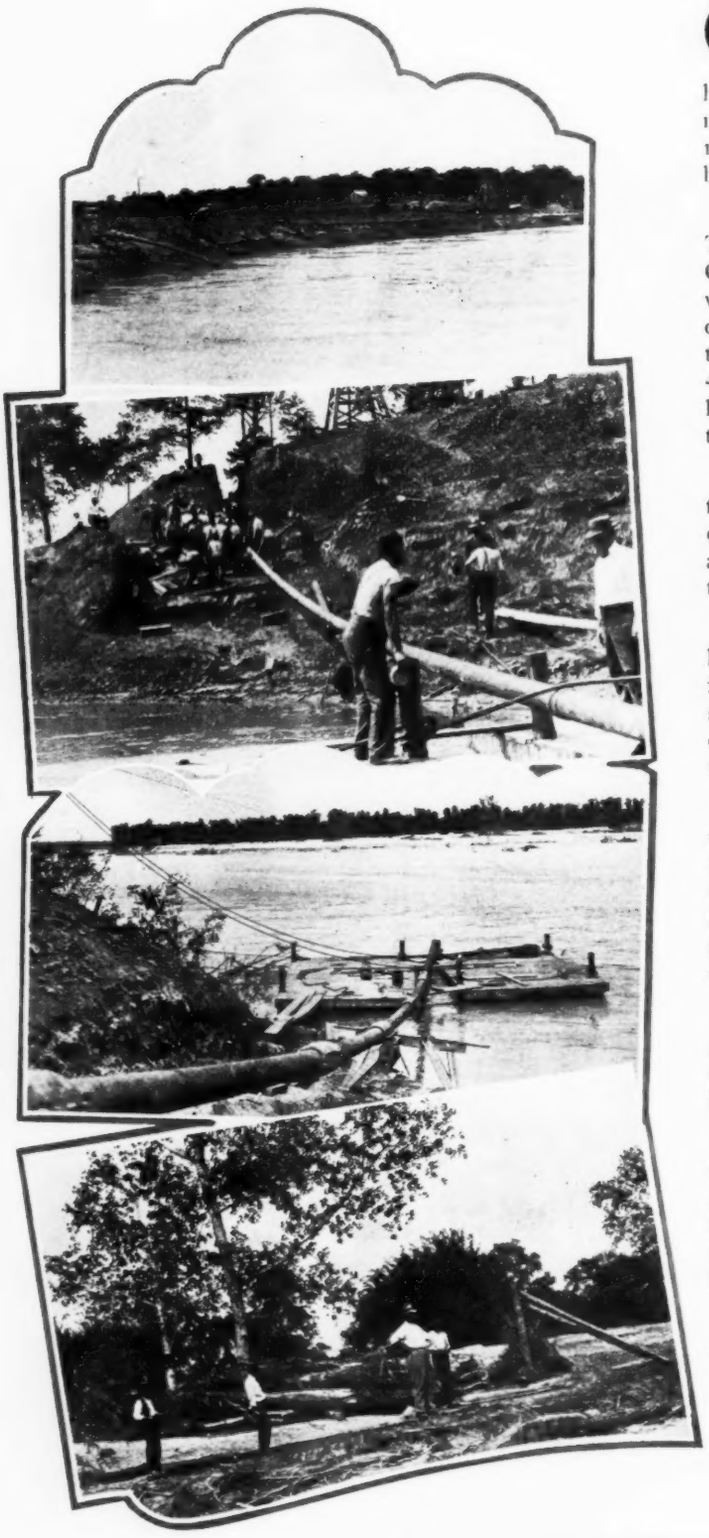
You are invited to ask for a sample of Republic Fire and Mill Hose, so that you may make your own comparisons.

THE REPUBLIC RUBBER CO.

Youngstown Ohio

REPUBLIC means the Best Mechanical Rubber Goods

River Crossings *Were Real* Problems



ON the Texas bank of the erratic Red River near Denison, stands a monument to the ingenuity of the pipe liner who took his troubles as a matter of course and handled them with whatever accessories he had at hand. This monument is nothing more than a small weather-beaten derrick that played its part in the repair of a river crossing break.

Back in the summer of 1908, less than a year after the Texas Pipe Line Co. completed its 8-inch screw line out of Oklahoma to the Gulf Coast, the Red River played havoc when it went out of its banks. Any old-timer can recall the destruction of that flood. At the point where the line crossed the river the current changed its course and cut away about 40 acres of land. In doing so it ripped out a section of the line on what was the river bank. The line with clamps in the river bed was intact, but could not be used.

Every bit of line capacity was urgently needed at that time and a rush repair job was urged. The sixty days required to repair the break loomed like weeks to the officials as nature, day in and day out, thwarted attempts of the crews to span the turbulent stream with a new line.

W. T. (Bill) Cushing, known throughout the nation's pipe line "high-pressure" tents and also among pipeliners in some foreign countries, built the line, and at that time was general superintendent of the transporting company. With several other company officials he spent sixty long days on the job, most of the time watching the river.

Tug boats could not be brought into use and no barges were available. An old ship carpenter from New Orleans was found operating a plumbing shop in Denison. He was hired and built three barges on the banks of the river. In the meantime preparations were being made to get a cable across the river so the barges could be moved and controlled.

On the Oklahoma side an anchorage was made of old pipe and logs. To make sure of a secure anchorage the cable was lashed to a number of trees farther back on the bank.

On the Texas side the derrick was built to use in putting a tension on the line. The top of the derrick was 70 feet above the flood water level. The wire line was strung over the crown block and down to the bull wheel. The derrick was rigged with a block and tackle to put tension on the line in a manner similar to that used in pulling casing.

Getting that line across, however, required patience, skill and agility. First, a pilot line of quarter-inch twine was

Top to bottom—How the Red River sliced away 40 acres of its bank near Denison, Texas, and washed away part of the Texas Pipe Line Co.'s river crossing. The line can be seen in the left foreground; replacing the line which was damaged; starting out from the bank with new line; part of the cable anchorage on the Oklahoma side.

on the First Mid-Continent Pipe Lines

taken across and easier written than done. Trees and driftwood made it extremely hazardous to use a skiff, and later this same menace caused much delay in work. Those working in the skiff were many times forced to get their boat out of the way of the splintering force of a tree or log. Thousands of feet of twine were washed away when it got tangled in driftwood and was broken.

Finally the pilot line was taken to the opposite shore and it was used to drag the ⅝-inch rope sand line across. This was in turn used to pull the quarter-inch steel cable across, which was raised above the surface of the water with the aid of the derrick.

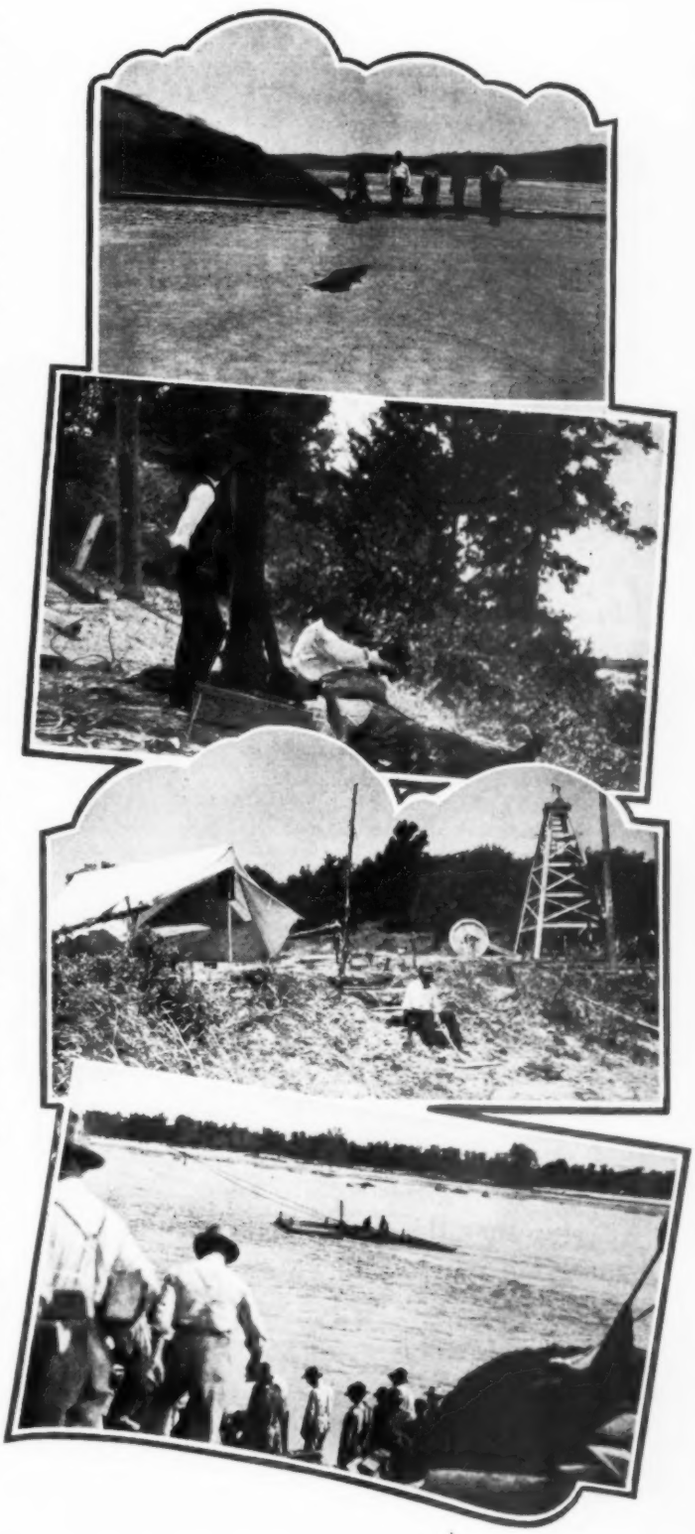
The quarter-inch steel line held the weight of a man, and with a sling carriage he worked his way along the line over the river, putting on clamps similar to those used on telephone line cables, so a bigger line could be strung across. In this slow and tedious manner the 1¼-inch steel cable was put across, and all was in readiness, apparently, to build the crossing.

Another delay halted work when it was feared the drifting logs and trees would splinter the barges and possibly cause the death of a score or more. The water was heavy with silt, which made it extremely difficult for a man to swim. Consequently, the approximately 100 laborers, at $5.00 per day, basked in the sunshine and watched driftwood churn down the river.

Another concern was the unusual rise and fall of the river, which was five and six feet some days. This was brought sharply to the attention of the crews when they almost lost a barge loaded with tools and equipment. During the night the river fell suddenly, leaving one of the barges on the bank and the other in water. This caused the barge to list and ship water. Thereafter, watchmen followed the rise and fall of the river and played out the lines when necessary.

When the flood waters and their attendant dangers permitted fairly safe work mid-stream, the crews started building the crossing. Two barges lashed together and moved and held in the proper course by the 1¼-inch cable, were used to make up the joints and put on clamps. The third barge was used to carry supplies.

During the same flood the Gulf Pipe Line Co. lost its Red River crossing. That line was near the M. K. & T. railroad bridge at Denison. The bridge was moved four feet out of line by the flood waters, and when it was put back in service the Gulf was permitted to lay two small diameter lines on the bridge for the emergency.



Top to bottom—The new line at the river bank; watchful waiting; Joe Dowling is standing, W. T. Cushing sitting, and Otto Holleran reclining; the watchman's tent on the river edge; in mid-stream with the new line.

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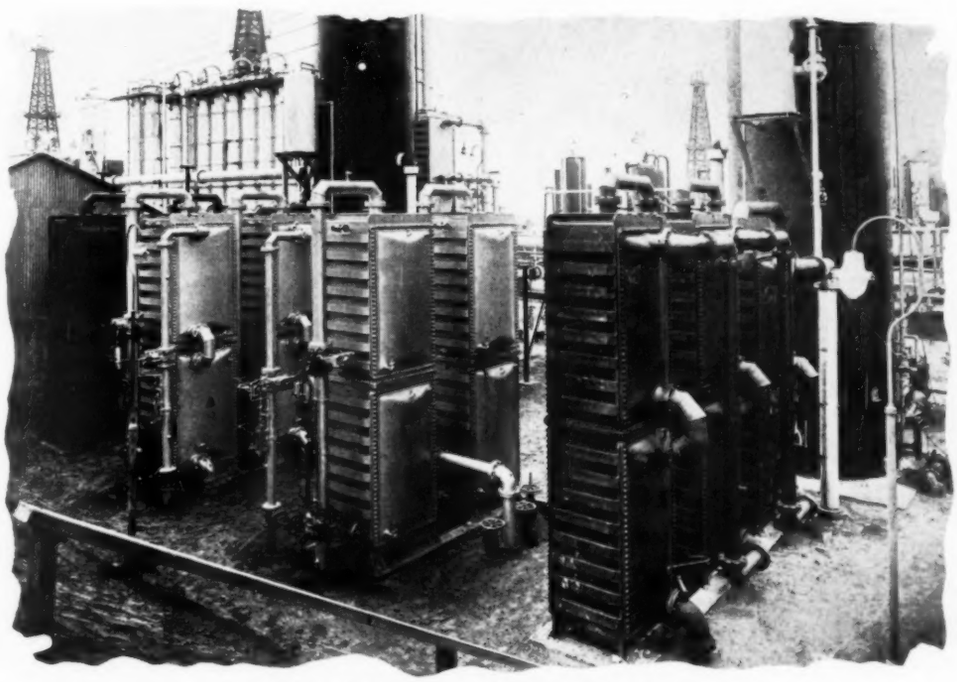
The Distribution and Exchange of Heat in a Natural Gasoline Absorption Plant

By HERBERT J. JONES,
Union Oil Company of California

THE absorption process of extracting natural gasoline from natural gas is essentially one depending upon the correct application of heat at certain selected pressures. Because the process is clearly defined and well developed, the apparatus necessary to accomplish the desired result of producing natural gasoline can be quite simple if there is no regard for operating economy. However, in the California oil fields, with large communities at hand for the utilization of natural gas as a fuel, the industry demands high fuel economy. Yet this demand must at all times be tempered by the allowable cost of apparatus for each particular plant. For one thing it is well known, with sad experience to some, that the life of an absorption plant can only continue so long as the oil sands are productive. This in itself limits the first cost of the plant, because a large portion of the money is expended on cooling tower basins, foundations and boiler settings that have little or no salvage value. It is also true that there must exist an economical balance between first cost and operating expense, and therefore the design of any particular plant under observation is undoubtedly the result of a careful scrutiny of all conditions existing at the time of construction and of those forecast for the future. Necessarily, then, various owners in different locations have built plants quite widely divergent in characteristics. Some plants represent the one extreme where a short life is predicted and as little as possible is spent on apparatus. This type of plant is quite likely to be wasteful of energy and the cost of operating may be expected to run high. Another extreme might be found in a plant built to be quite economical in the use of heat energy with a resulting high expenditure of mechanical energy. Still another plant might be found where the equipment had been installed on a generous plan. This plant would then have heat exchange equipment of such design and capacity that the process would be operated with a minimum input of heat energy and the mechanical energy would be correspondingly low. It may be expected that such a plant would be situated in a field so controlled that the life of an absorption plant would extend over a considerable period. Therefore, it can easily be realized that any set-up chosen for description could not be considered universal in use, but only adaptable to a particular group of conditions. It is true that there has been considerable work done in improving the design of an absorption plant and many different types of construction are now represented in the equipment of each particular phase. However, this article is concerned solely with the heat exchange apparatus of an installation to conform to some set of conditions known to fall somewhere within the limits briefly mentioned.



Heat exchangers in a California gasoline plant.

Briefly it must be recognized that there exists in this system various combinations of liquids and vapors at temperatures ranging from 350° F. down to perhaps 55° F. At any temperature between these two possible limits there may be an exchange of heat taking place under certain conditions imposed by the result of an arbitration between initial cost, operating expense and the desired function of the apparatus. For instance, a preheater might be of such design that the final temperature of the heated oil would be within 2° of steam temperature. Yet, for obvious reasons, a preheater operating at its rated capacity never reaches this condition. Therefore in order to illustrate the above items a mythical heat exchange system will be selected and the distribution, exchange and dissipation of this heat will be considered. Further, the system selected will be restricted to certain imposed pressures.

The customary low pressure absorption plant operates at a gas intake pressure of approximately 30#/sq.in. gage. For various reasons this pressure has become more or less standard. Two of the most apparent influences in this standardization are probably found in, first, the characteristics of the compressors being manufactured and second, the interconnecting of Public Service Gas Corporation compressor plants

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and absorption plants. In the first regard it is true that for a single stage of compression, with an intake pressure below atmosphere, a discharge pressure between 30# and 40# is as high as practical. Therefore after the gas is passed through a cooling coil the resulting pressure is usually in the range between 25# and 35#. With this pressure on the intake gas it is not unusual to have a pressure of 40# on the still and a rundown tank pressure of approximately 32#. Now for the sake of illustration an assumption will be made placing the available production at 9,000 Mcf. of wet gas testing 1.450 Gal./Mcf. by charcoal. An absorption oil circulation of 46.5 Gal./Mcf./hour should be sufficient to strip this gas. Therefore an oil circulation of 17,400 Gal./hour may be assumed, and the fat oil volume would be approximately 18,000 Gal./hour and would vary with the volume of light hydrocarbons absorbed. Now there are two separate heat exchange systems; one involves the absorption oil, the other concerns the vapor passing from the still. Considering the absorption oil, it may be assumed that the fat oil leaves the absorbers at some temperature such as 90°. This oil contains the desirable material which must be extracted by fractional distillation. In order to accomplish this at 40# still pressure, without the use of agitation steam, excessively high temperatures would be required. Therefore the use of agitation steam is general and is admitted at the base of the still and serves the double purpose of agitating the oil and lowering the partial pressures exerted by the hydrocarbons present. This lowers the boiling points of the desirable fractions and a base temperature of 335° will suffice to complete the desired extraction. Now all heat, other than the heat of absorption picked up in the absorbers, is supplied from the combustion of natural gas and may be conducted to the absorption process by means of steam as a medium. The first direct application of this heat in the absorption oil system is carried on by means of the fat oil preheater. However, for fuel economy, the fat oil is initially heated in the absorption oil interchanger. This piece of equipment allows an exchange of heat to take place between the hot lean oil coming from the still bottom and the cold fat oil proceeding toward the still. In design it consists of a number of rather small diameter tubes enclosed by a shell. The cold fat oil is usually pumped through the tubes and lean oil flows through the shell. The total cross section of the tubes is such that the velocity of the fat oil is high enough to produce turbulent flow. This type of flow prevents the oil from following straight line film paths at varying velocities, depending upon the position of each film with regard to the tube walls and thereby obtains a higher heat transfer per square foot of area. It must be recognized however, that this turbulent flow is only attendant to the expenditure of considerable mechanical energy necessary to pump the fat oil against the high pressure drop of the small diameter tubes. Therefore this is the first instance where an economical balance in design must be struck to allow a fairly high heat exchange per square foot of surface without a too excessive consumption of energy in pumping the oil. In practice for the hypothetical case involving a design built to handle a circulation of 18,000 Gal./Hr. of fat oil, an interchanger might have the following characteristics. The fat oil enters the tubes at a pressure of 135# and discharges at 110#. Therefore the pressure drop is 25#. The fat oil enters at a temperature of 90° and leaves at a temperature of 275°. This represents a heat exchange of some 12,500,000 B.T.U. and involves a rate of exchange somewhere in the neighborhood of 105 B.t.u./sq.ft./Hr./1° M.T.D. The lean oil enters the interchanger at 330° and leaves at a temperature of 145°. Now it is undoubtedly true that the lean oil, at a temperature of 145°, holds considerable available heat when discharged from the interchanger, but for this set up it will not be considered feasible to endeavor further exchange.

A natural gasoline plant in Texas.

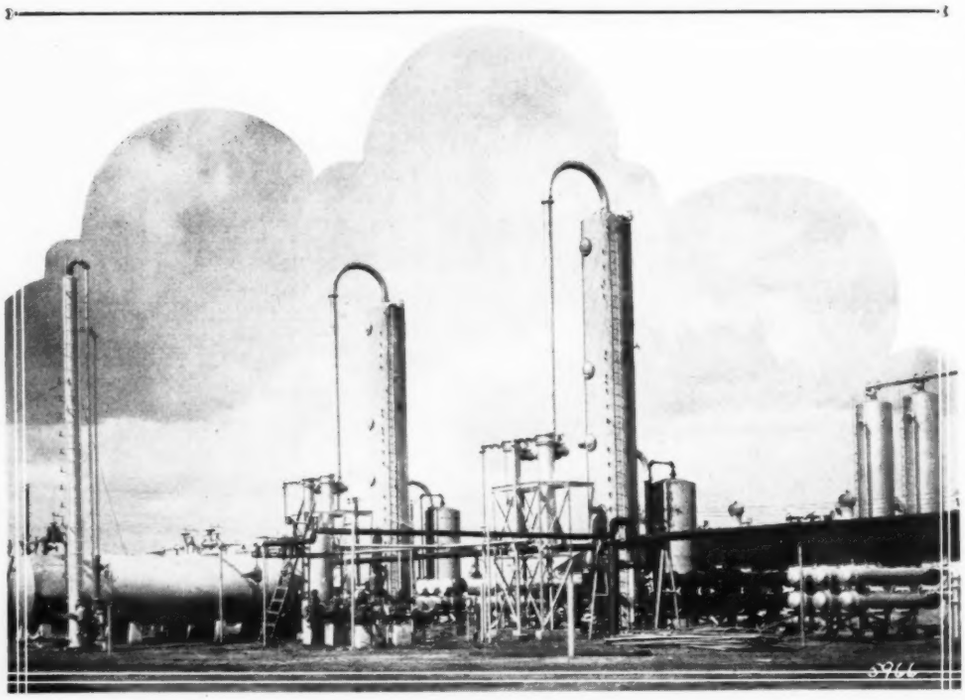
From the interchanger the heated fat oil passes to the live steam preheater and here again turbulent flow must be utilized to effect high heat transfer. In this piece of equipment a pressure drop of 70# will be selected and this will mean a pressure of 110 pounds for the fat oil entering and a pressure of 40# on the oil leaving the preheater. The incoming fat oil will have a temperature of 275° and may be assumed to approach within 20° of steam temperature. The steam pressure assumed may be 150# and the fat oil then approximates 345° at the outlet. The steam temperature is 366° and the prevailing heat transfer of 315.0 B.t.u./sq. ft./hr./1° M.T.D. might provide a total exchange of 5,500,000 B.t.u./hr.

The cooled lean oil from the interchanger flows to the oil cooler in a cooling tower and it is observed that a new requirement becomes of greatest importance in the design

of the coil for this exchange of heat. It is well known that the temperature of the lean oil has a definite bearing on the efficient extraction of desirable hydrocarbons from the gas treated and therefore a proportionately large cooling surface is provided in order that the cold oil may approach within a few degrees of the temperature of the water hitting the coil. The warm oil enters the coil at 145° and leaves at 79°. This is within 2° of the water temperature of 77° and may be obtained if sufficient cooling surface is provided. The total heat exchange might be 4,000,000 B.t.u. and the coefficient of heat transfer could then be 60 B.t.u./sq. ft. /hr./1° M.T.D.

Now the vapors entering the dephlegmators from the still consist of steam, gasoline vapors, fixed gas and reflux vapors. In this cooling equipment practically all of the steam is condensed and cooled to outlet temperature as is the reflux. The gasoline vapors and fixed gas are cooled to outlet temperature but are not condensed. The vapors enter at a temperature of 245° and leave at 185°. Now there is a double purpose in installing a dephlegmator. It removes all the material from the rundown stream heavier than that desired in the finished product and thus condenses a portion of the still vapors to be returned to the top of the still to act as reflux in the fractionation. However, this condensation must be accomplished with a minimum pressure drop and for this reason the heat exchange per unit area is not as high as might be obtained at the existing temperature range if a higher pressure drop were permissible. In practice, for the system considered, the vapors enter at 245° and leave at 185°. Now there are several distinct constructions possible in this equipment. The dephlegmator might be a coil suspended in an individual cooling tower or a coil submerged in some form of water container. In the first case the heat is directly dissipated to the atmosphere. In the second case the water from the shell of the exchanger is pumped to a cooling tower to be cooled and is then returned. The first installation requires small tubes with de-scaling characteristics as cooling tower water concentrates and forms heavy scale on hot pipe. The second installation may be constructed of iron pipe in an open wooden box and used in conjunction with a soft water closed cooling system. The iron pipe is protected from corrosion by means of the addition of sodium dichromate to the soft water. For a typical installation of the latter construction, a heat transfer of 85.0 B.t.u./sq. ft./hr./1° M.T.D. is readily obtained. The total heat involved would be approximately 3,600,000 B.t.u./hr. Of this total, the heat extracted in condensing agitation steam might be as high as 2,600,000 B.t.u./hr. As mentioned above, the final dissipation of this heat is taken care of by means of a closed water system leading to a cooling coil in a cooling tower. However, as the selected dephlegmator boxes are open to the atmosphere and the outgoing water is often over 200°, there is considerable heat dissipated by vaporization of water from the boxes. This vaporization often removes 20 per cent of the total heat exchanged in the dephlegmator boxes. Consequently, of the 3,600,000 B.t.u./hr. there would be 720,000 B.t.u./hr. dissipated at the boxes and 2,880,000 B.t.u./hr. conducted to the cooling coil in the tower.

The remainder of the heat involved in the vapor stream leaving the dephlegmator is dissipated in the gasoline condensers which again might be constructed in several different ways, but those selected will be suspended in a cooling tower. Here again final temperature is of paramount importance and a very low heat exchange per square foot is accepted. Of course this low value is partially a result of the low temperature range existing. At any rate the total heat might be 800,000 B.t.u./hr. and the heat exchange would be approximately 30 B. t. u. / sq. ft. /hr./1° M.T.D.



Natural gasoline plant in Oklahoma.

The values herein reported are not universal in plants now in operation. However, a particular set of conditions influencing the construction may be assumed to produce a plant of such characteristics. Therefore, for some such plant these values do allow a comparison between the various pieces of equipment and several items are at once apparent. Briefly it may be seen that high pressure drops can only be tolerated where high pressures have no direct bearing on the process other than the amount of energy consumed. In the oil coolers a very high pressure drop is accepted because the high heat content of the oil requires considerable surface to lower the temperature to within a few degrees of water temperature. The oil interchanger allows a substantial saving in heat. The value of the coefficient of heat exchange varies considerably and depends upon allowable pressure drop, existing temperature range and desired final temperatures of media. For the various pieces of equipment the controlling factor, or factors, is different. For the oil cooler it is the final temperature of the lean oil. For the dephlegmator it is a minimum pressure drop, as every additional increment of pressure added to the distillation pressure necessitates either a higher still temperature or else the use of more agitation steam.

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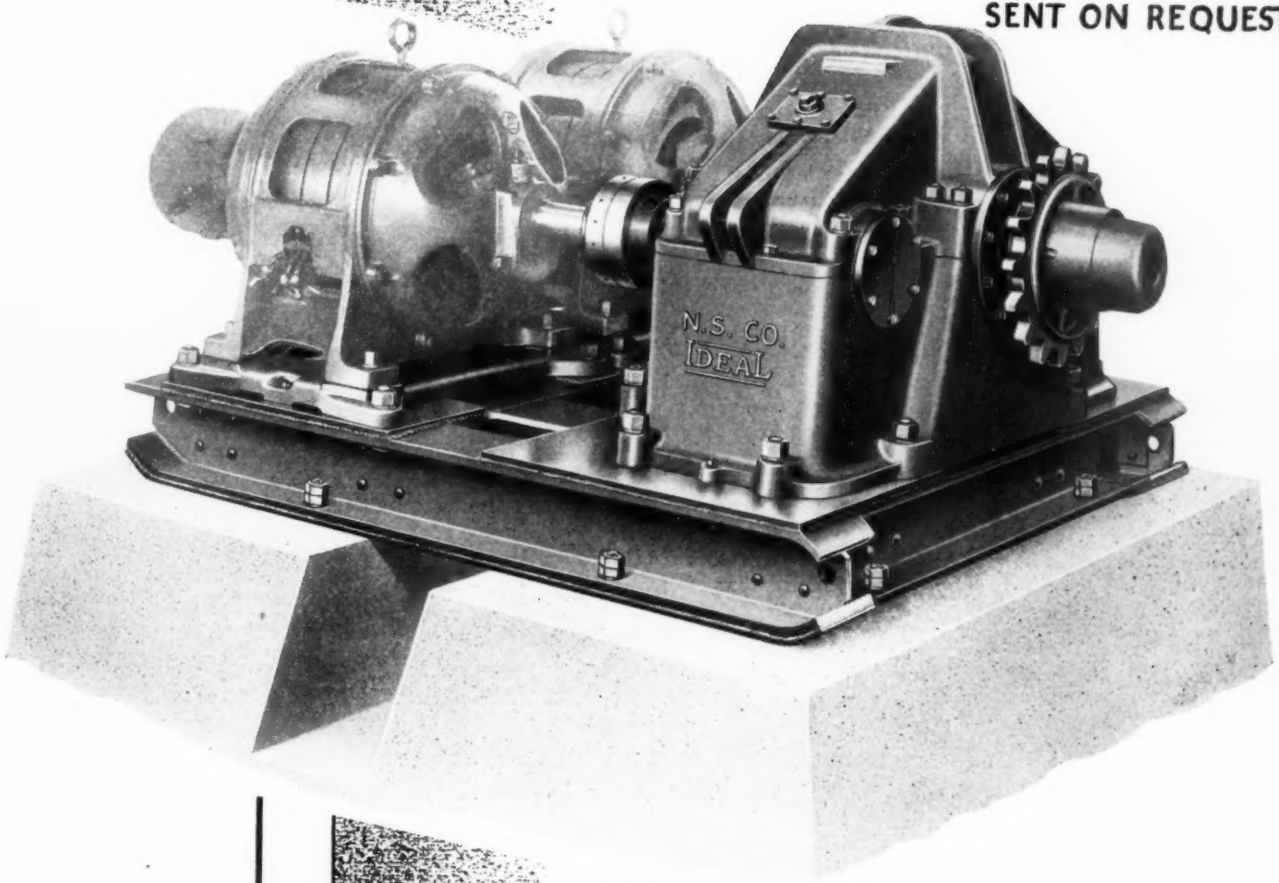

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Recently Completed

Natural Gas Line to Old Mexico

THE first arc-welded pipe line in Mexico, constructed for the transportation of natural gas for the Compania Mexicana de Gas, a subsidiary of the United Gas Company, has recently been completed. This new line is fabricated of 12-inch pipe and is 165 miles long, running from the Jennings field in Zapata County, Texas, to Roma, Texas, then across the Rio Grande River, via the International Bridge to San Pedro, Mexico, and thence to Monterrey, Mexico. It was constructed by the Smith Bros., Inc., general contractors of Dallas, Texas, and was started from both the United States and the Mexican sides of the Rio Grande, the two gangs working toward each other.

In the construction of this line, as is customary on all pipe lines fabricated by the arc welding process, the pipe was distributed along the right-of-way and lined up in sections, ahead of the firing line welders as they progressed. These sections are composed of from 6 to 8 lengths of pipe, lined up on skids and tack-welded by the welding operator assigned to the section. After the tack welds have been applied to a complete section, the welder returns to the first joint and applies the burning-in bead half-way around the circumference. The pipe is then turned and the remaining half is welded. The operator's helper follows him across the section, cleaning the burning-in weld in preparation for the finished weld. While the finished weld is being applied, the helper turns the pipe continuously so that the finished weld may be completed in one continuous operation.

As the sections are completed they are placed over the ditch on skids and the tie-in welds are made by the bell hole gangs. In making these connections, the weld must progress around the pipe as it remains stationary, because it is impossible to turn the entire line. The current for welding this line was furnished by 90 gas engine-driven welders. Of this number, 48 were used on the portion of the line in the United States and 42 on the Mexican portion. The welders were moved into position along the line by caterpillar tractors.

The several views above show construction scenes on the gas line to Monterrey, Mexico. Particularly interesting is the photograph on the lower right showing ceremonies at the formal turning on of the gas.

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Quasi-Arc welding requires the very low current of 70 to 120 amperes, which avoids the overheating that with ordinary electric welding so often renders the base metal brittle and unreliable.

An idea of the unequalled quality of Quasi-Arc Welds may be had by comparing them with oxy-acetylene. Ordinarily, oxy-acetylene welding is considered to be superior, as well as more expensive, to electric welding. However, it has been proven that a normal Quasi-Arc weld made by an average welder is as good in every respect as the finest weld obtainable with oxy-acetylene. Furthermore, Quasi-Arc welds are made in less than half the time. This is due to the scientific design of these electrodes, which assures a smooth, easy deposition of metal, practically eliminating the human element. Heretofore this "human element" has been one of the greatest obstacles to the progress of electric welding.

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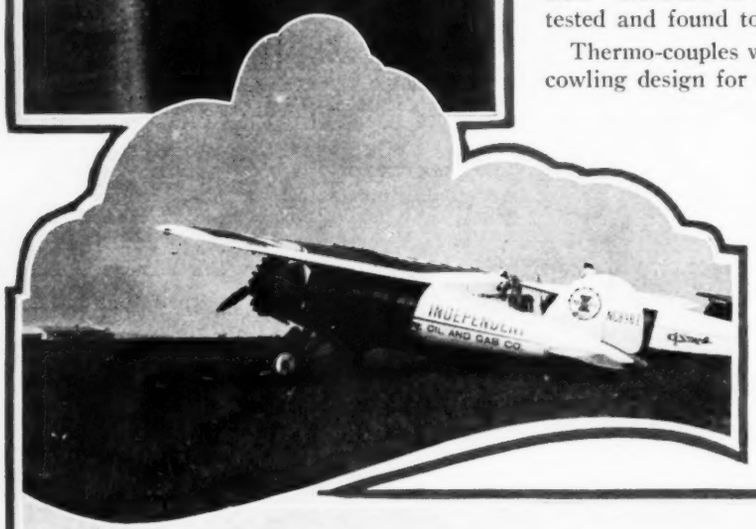
Performance Characteristics *of* Aviation Oil

By WARD DAYTON
Aviation Engineer, Texas Pacific Coal & Oil Company



IS pressure drop always caused by decrease in viscosity? This very popular aviation question was answered through a recent test run on a new model plane. The plane was given a series of flight tests to "iron out the bugs." Every time the pilot would take it up and run the engine above 1700 R. P. M. he would land after about ten minutes because of a drop of 25 to 35 pounds in the oil pressure. After doing all that could be done to ascertain the trouble on the field, without success, the engine was pulled and disassembled. Engineers from the factory went over it with an eagle eye, looking for the cause of the trouble. Nothing was found that could be the cause of this trouble.

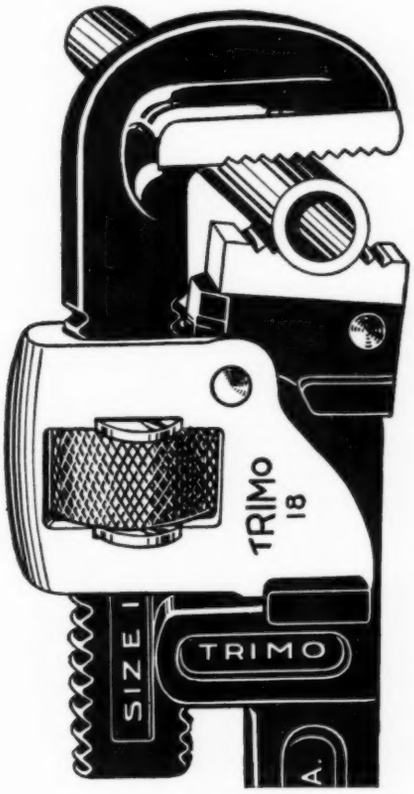
The oil being used was a brand of proven quality, approved through laboratory and service tests, 115 to 120 viscosity at 210 degrees F. The oil company representative was called in and acquainted with the situation. Needless to say, he took a sample of the oil in the tank, had it tested and found to be up to specifications.

Thermo-couples were installed on different parts of the engine to check cowling design for cooling efficiency, although oil outlet temperature did not indicate any abnormal condition. In checking the operating temperatures both on the ground and in the air, they were found to be normal until the engine was run above 1700 R. P. M. for a few minutes, when the pressure drop occurred. The operating temperatures increased to as much as 20 degrees above normal on different parts of the engine, depending upon the engine speed above 1700 and the length of time run at this speed.

The performance is indicated by the curves. Figure 1 shows the drop in oil pressure with the increase in engine speed above 1700 R. P. M. Figure 2 shows the increase in outlet temperature with the drop in oil pressure.

The test runs proved that the oil did not thin out because of increased operating temperatures, as these temperatures did not occur until after the pressure drop. This condition, of course, was puzzling and the quality of the oil was questioned. To check this another oil of good quality, approved by the engine manufacturer, was put in the tank. Similar tests were run with the same results. After these unsatisfactory tests, the oil pump was replaced with one from another engine, which had been tested and approved. Results were no better.

When this change was made, the factory



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engineer had an enlightening thought. He examined the oil tank, and said: "There's our trouble."

The solution of the puzzle was found to be in the tank. The engine has three oil pumps, one pressure and two

An airplane of the Continental Oil Co. at Edmonton, Canada.

for scavenging. The capacity of the two scavenging pumps is much greater than that of the pressure tank. One sucks the oil from the nose and intermediate section of the engine, and the other sucks the oil from the main crankcase and rear section. They, of course, were sucking a lot of air along with the oil, since their capacity was greater than that of the pressure pump. This fact, the way the oil tank was constructed and the location of the oil return pipe in the oil tank, caused the oil to foam very much. The oil did not have time to settle when the engine speeds were above 1700 R. P. M. Consequently, when the engine was being operated above that speed, oil delivered to the engine by the pressure pump contained considerable air. The first oil tank is too shallow and broad and the oil return is located directly over the oil outlet. What took place in the tank can be seen from the accompanying sketch of the first tank, Figure 3.

The new tank was much narrower and deeper, with the oil return pipe flattened out on the discharge end and located so that the oil was directed against the side. This gave the oil a chance to settle before being delivered back to the engine. The oil being directed against the side of the tank also aided in cooling it. Figure 4 is a sketch of the new tank.

FIG. 3

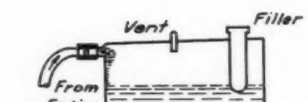


FIG. 4

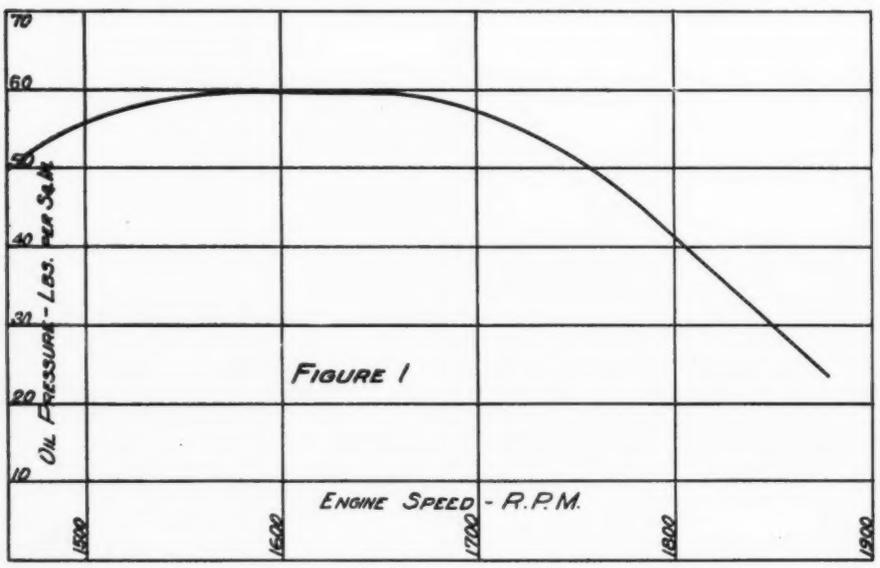


FIGURE 1

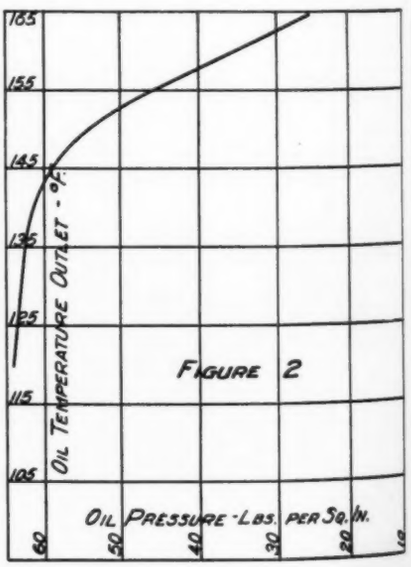


FIGURE 2

Equipment and Operation of

Modern Gas Measuring Stations

By D. A. Sillers

Superintendent of Measurement, Lone Star Gas Company

METERS are often called the cash register of the gas company. As a matter of fact, they are really much more important than the cash register, inasmuch as they are the original source of the figures which make up practically all of the gas company's income and a very large part of its outgo. For this reason it behooves the executives of every gas company to make sure that their measuring stations are properly designed, the proper equipment installed and that they are operated by competent men.

D. A. Sillers

Gas is measured first at the wells where it is either produced or purchased. The type of setting used varies greatly between the different companies. The installation most commonly used by our company consists of an orifice flange on the well line near the well, at some point where the line slopes downward away from the well. This tends to keep condensed liquid from running back down the line to the orifice setting. We do not use bypasses on well meter flanges, as the well gate and the line gate can be closed at any time it is desired to change a plate. A substantial box is built around the flange and gravel the bottom of the flange box and the floor around the flange box. A standard six-by-eight corrugated iron meter house is our favorite, and we always install a door on the front and the back of the meter house in order to give light and ventilation when working on the meter in hot weather, and also as a safety measure in case of any accident. The investment in the meter house is justified by the protection it gives the charts, chart changer and meter inspector during bad weather.

Many companies use a bypass running above the ground as a meter run, some installing a meter house over the flange and meter and others installing a small meter house over the meter gauges only. In some locations it has been found necessary to install heaters over the orifice flange with the vent pipe rising close behind the meter gauge in order to prevent freezing. It has been our experience that where there is not too much condensate in the gas the complete elimination of leaks in the meter piping has practically eliminated our troubles from frozen meters.

Most of our sales in the field are measured through large-capacity positive meters with pressure, time and volume recording gauges. All these meters are equipped with a bypass and a test connection on the outlet. In order to protect our meter diaphragms from excessive overloads, we install a suitable-sized orifice disk in the outlet of the meter which will not pass more than the capacity of the meter. These meters are also covered by the same corrugated iron meter house with two doors.

Most of the main line meters on our system consist of a flange in the main line around which is built a concrete flange box with a standard field meter house over the flange box. It is difficult to change plates in these flanges, and usually when it is desirable to change a plate it is not possible to shut down the line for that purpose. Our last main line measuring stations built consisted of headers across the main line with vertical risers out of the headers to two orifice meter runs located above the ground. The cost of four small gates is not much greater than two large main line gates. As the valves are located on the risers they do not collect dirt and are found to hold better. By using a small orifice plate in one line, a large orifice plate in the other line, and both lines during peak loads, we have three changes of range, and when we do wish to change orifice plates it is comparatively easy to do so.

In city gate-measuring stations the measurement and the regulation of the gas are two problems which are naturally combined. Poor regulation of the gas results in meter charts which are difficult to read accurately.

A measuring station on a main highway in Texas.

Figure 1 is a photograph which shows examples of almost all the "what not to do's" in gas measurement and regulation. There is no house over the installation. Weeds, etc., have been allowed to grow up around it. The first or high pressure regulator is a four-inch which is many times too large for the volume of gas handled. Either the diaphragm is too large or

the pressure gauge on the regulator is out of order, as a very excessive amount of weights are used on the lever arm. The high pressure regulator discharges into a two-inch regulator with practically no volume or cushion between the two. From the general appearance of the station we would infer that there are probably no straightening vanes, which would result in very poor measurement with the meter set so close to the regulator. There is no bypass around any part of the installation.

Fig. 1

Figure 2 shows a city gate station during construction. It shows the small regulator with a small head on the high pressure gas. The size of the regulators and heads increases as the gas expands to lower pressure. Where the first two regulators are close together a cushion is installed between them. The meter and each regulator have individual bypasses. A pop valve protects the meter and its pressure spring. There is a test tee and atmospheric tee on the outlet of the meter. Gauges were installed showing the pressure delivered by each regulator. This station was completed with a concrete floor and a neat corrugated iron building with windows and two doors. Such a station is a good permanent investment for the gas company. It insures good regulation and measurement at low operating expense.

We have found that by using three regulators to cut main line pressure to intermediate pressure we have eliminated freezing and the necessity of operating heaters, with the consequent fire hazard.

Figure 3 shows an arrangement whereby an additional

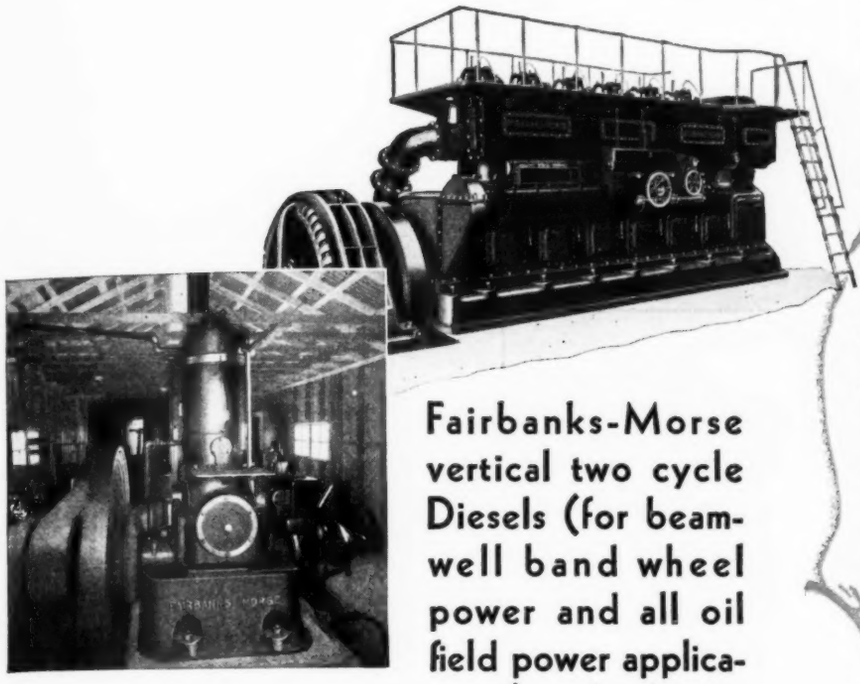
Fig. 3

regulator and cushion were installed in a station originally built with only two regulators. A number of such installations have been made with very satisfactory results.

The city gate measuring station is one of the few visible parts of a gas company's system. It is certainly good advertising for the company to have measuring stations that are neat, business-like and well constructed. A well-designed measuring station costs the company less money in the end and gives much more satisfactory results.

Fig. 2

The POWER TREND is toward the DIESEL



Fairbanks-Morse vertical two cycle Diesels (for beam-well band wheel power and all oil field power applications) embody the same principles of economy — reliability and two cycle airless injection simplicity as the larger —

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Some Difficulties in Handling

Cut Oil in the West Texas Fields

By HAROLD VANCE,
Consulting Petroleum Engineer.

THE Hendricks Field, located in Winkler County, Texas, presented more difficult problems to the operators than any field in West Texas. Large volumes of high-pressure gas at relatively shallow depths made drilling difficult. After a number of wells had been junked and large volumes of gas wasted, cable tools were abandoned for drilling in the big gas area. The problem was not entirely solved by the use of the rotary method. Mud was expensive and circulation was often lost at the most critical stages of drilling.

Harold Vance

Operators usually looked forward to the time when drilling would be completed and the attendant problems eliminated. But when wells were placed on production other problems arose. Water encroachment created a difficult treating problem. The disposal of large quantities of water added to this problem. The mixture of a large amount of gas, together with oil and water, formed an emulsion which was difficult to treat. Practically all known methods of treating were tried and in one instance all were partially unsuccessful. For instance, to treat the production from one well it was necessary to pass the fluid through a high-pressure oil and water separator, add chemical, then pass the fluid through an electrical dehydrator and into a heated flow tank to secure pipeline oil.

With a treating problem of this nature it was only natural that efforts were directed to perfecting a more economical treating plant. It was common knowledge that passing an emulsion through excelsior was a valuable auxiliary to the proper use of suitable chemicals in treating oil, because the excelsior presented a large surface upon which water collected. The most common method of using excelsior was in the so-called "hay tank". This installation is expensive and since there is no way of cleaning the excelsior, frequent replacement is necessary. The writer had in mind a portable treating plant using the excelsior principle, which could be mounted on a trailer and moved from place to place as batches of bad oil accumulated. The same apparatus could be made stationary if there were a continuous accumulation of bad oil. This apparatus as finally designed permits cleaning the excelsior either by reversal of flow or by the use of steam.

At one time all efforts failed to break up a thousand barrels of particularly bad emulsion on the Marland Hendricks A-Lease. Chemicals, heat, and gas agitation in various combinations were used for several days with little success. There was no time to build a "hay tank" because of lack of storage on the lease, so the writer, to achieve the same results, built what he calls the excelsior trap from materials available on the lease. An old joint of 15½-inch casing was swedged at one end and a 4-inch coupling welded into it. A 6-inch nipple was welded in a vertical position near the swedged end and a 2-inch coupling welded on the opposite side of the 6-inch nipple. The joint of 15½-inch casing was then stuffed full of excelsior, wooden baffle plates with spacers being placed every two feet. The other end of the casing was then swedged and a 4-inch coupling welded into it, and a 2-inch outlet welded into the bottom. (See Fig. 2.) The excelsior trap was placed so oil could be pumped directly through it from the wells on the lease and was provided with a by-pass connection so oil could be pumped from the stock tanks through the excelsior trap and back again to the stock tanks. The emulsified oil was then pumped through the excelsior trap. The emulsion was broken down and pipeline oil obtained the first time the fluid was pumped through the trap. This excelsior trap has been in use since it was first installed to treat current well production. Figure No. 1 shows it installed between the separator and the flow tank. Equally good results were obtained with the excelsior trap between the wells and the separator. Figure No. 2 is a diagrammatic sketch showing the construction of the original excelsior trap.

The second excelsior trap was installed on the Texas State Oil Co.'s Hendricks H-Lease in the north end of the Hendricks Field. Figure No. 3 shows the wet-oil inlet end and Figure No. 4 shows the clean-oil outlet end on this installation.

The first installation on the Marland properties proved so successful that a second excelsior trap was installed on its Hendricks B-Lease. This trap had some improvements over the first trap. It had a skimming outlet and the flow could be reversed by turning the trap end for end and by rotating it 180 degrees. This trap was constructed from two joints of 12½-inch casing screwed together. Before the excelsior trap was used it was necessary to heat all the oil produced on this lease to 180 degrees F. After the installation no heat was required and chemical costs were reduced considerably. Figure No. 5 shows

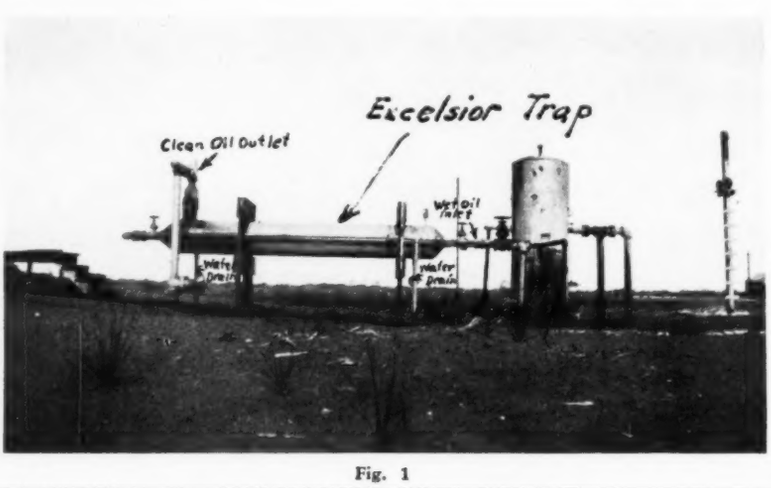


Fig. 1

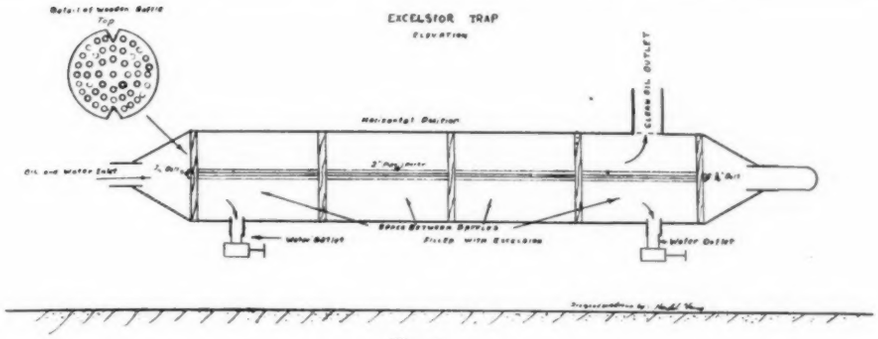


Fig. 2

the installation on the Marland Hendricks B-Lease and Figure No. 6 is a diagrammatic sketch showing the construction.

The excelsior trap has also proven successful in the McCamey Field, Upton Co., Texas, on the Marland Estep Lease. This installation is identical in construction to the one shown in Figure No. 6. Treating costs on this lease have always been high due to an unusually "tight" or refractory emulsion. The installation of the excelsior trap on this lease proved of valuable assistance in treating the oil.

A large number of wells in the Hendricks Field are equipped with some form of high-pressure oil and water separator, in which the full well pressure is thrown against the separator. The cutting of the oil at the choke is thus prevented as the oil and water separate under pressure and the clean oil and water pass out through different chokes. These high-pressure oil and water separators are of various designs, but all operate on the same principle and work satisfactorily.

It is possible to make a combination excelsior trap and high-pressure oil and water separator out of every high-pressure oil and water separator in the field. The writer has made combinations using two different types of high-pressure oil and water separators in different parts of the field. Each was used during the flowing stage. The first installation of this kind was on Marland Hendricks No. 6 well. Figure No. 7 shows the installation at the well and Figure No. 8 is a sketch showing the method of construction. At the time the change was made Hendricks No. 6 was flowing under

Fig. 3

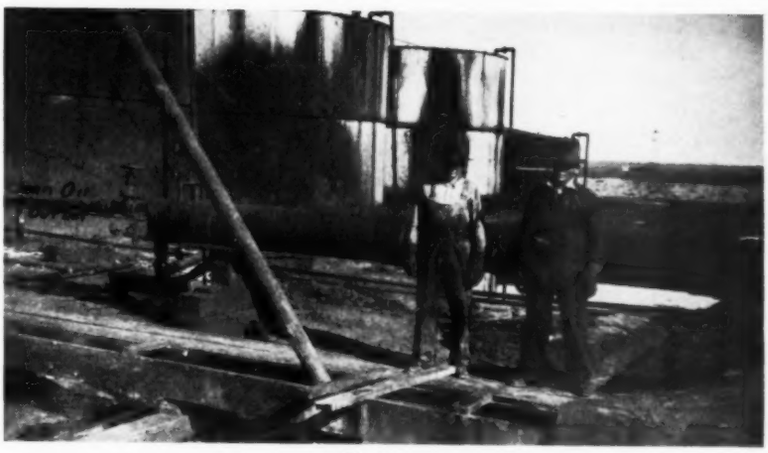


Fig. 4

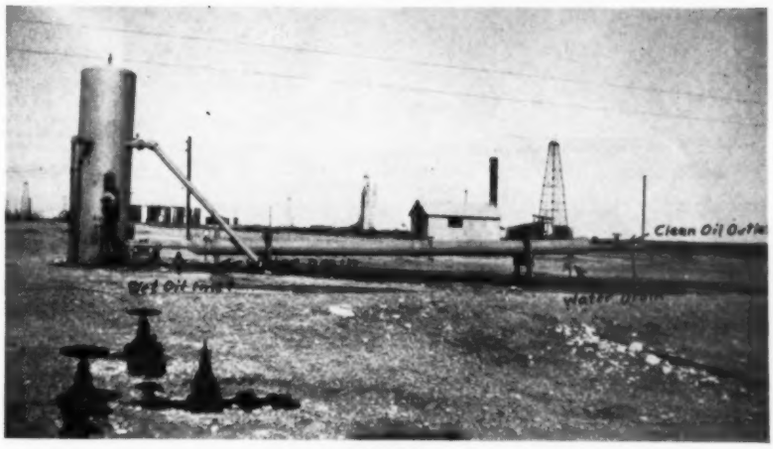


Fig. 5

Fig. 3 shows the wet oil inlet of an excelsior trap set on the Texas State Oil Co.'s lease in the Hendricks field, Fig. 4 shows the outlet end of the same installation, while Fig. 5 illustrates an installation on the Continental Oil Co.'s Hendricks B lease.

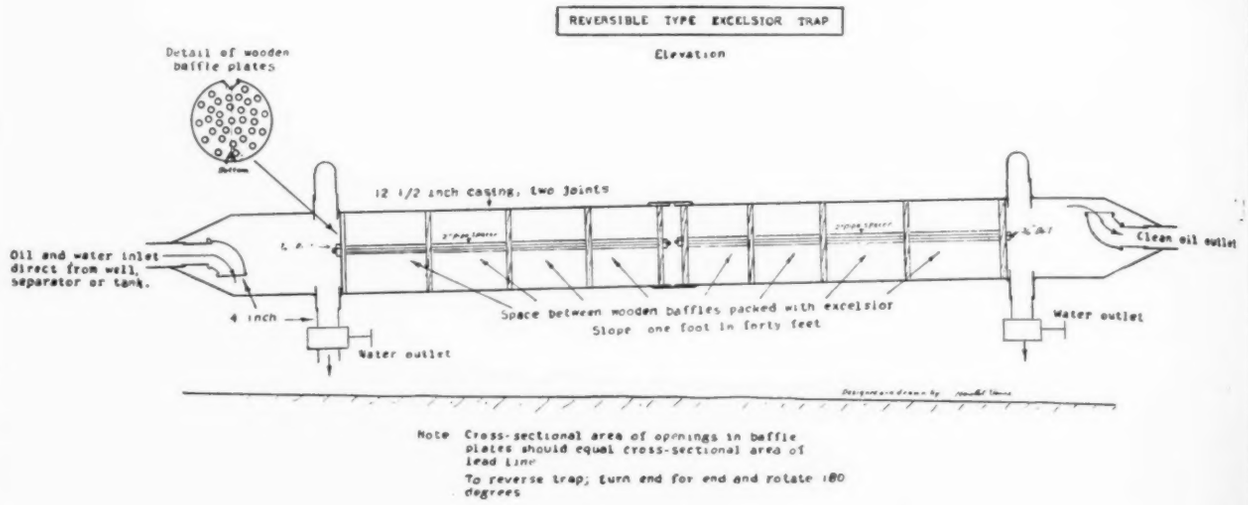

REVERSIBLE TYPE EXCELSIOR TRAP
Elevation
Detail of wooden baffle plates
12 1/2 inch casing, two joints
Oil and water inlet direct from well, separator or tank.
4 inch
Water outlet
Space between wooden baffles packed with excelsior
Slope one foot in forty feet
Clean oil outlet
Water outlet
Note Cross-sectional area of openings in baffle plates should equal cross-sectional area of lead line
To reverse trap; turn end for end and rotate 180 degrees

Fig. 6

150 pounds back pressure. The results obtained were very satisfactory.

The second combination excelsior trap and high-pressure oil and water separator was made from a high-pressure oil and water separator on the Texon Oil and Land Co.'s Hendricks B-Lease. This well was flowing under 50 pounds pressure, but after the installation of the excelsior the well would not make its production due to increased resistance to flow.

The excelsior trap has proven its usefulness in two fields in West Texas. The small initial cost makes it worth trying in other fields.

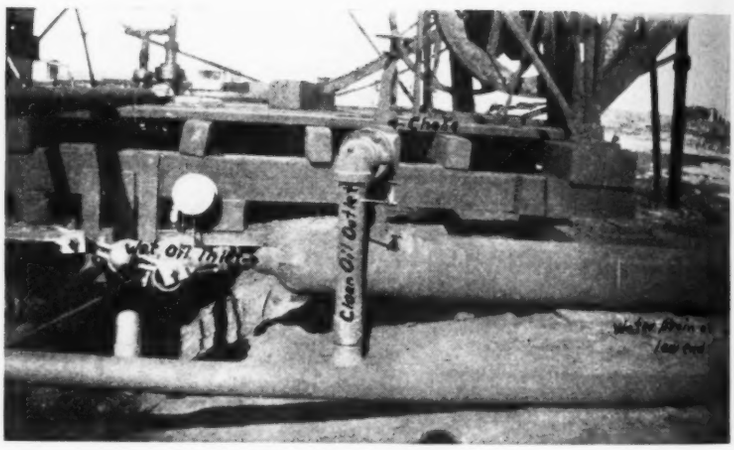


Fig. 7

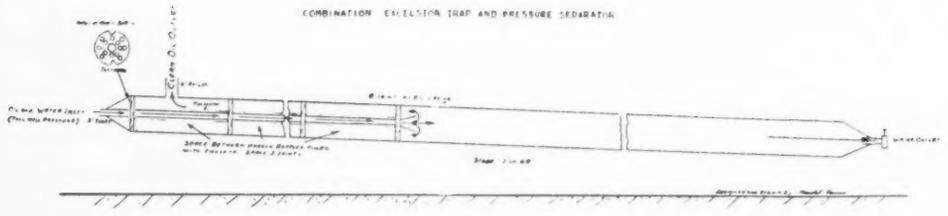
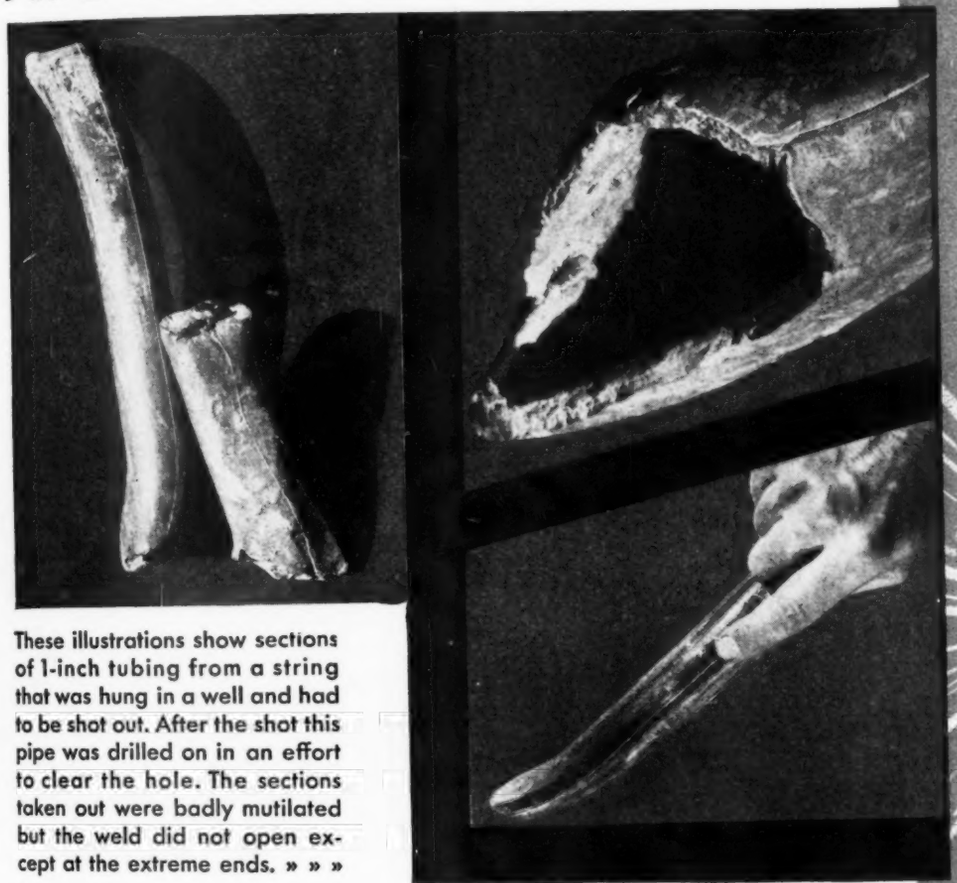


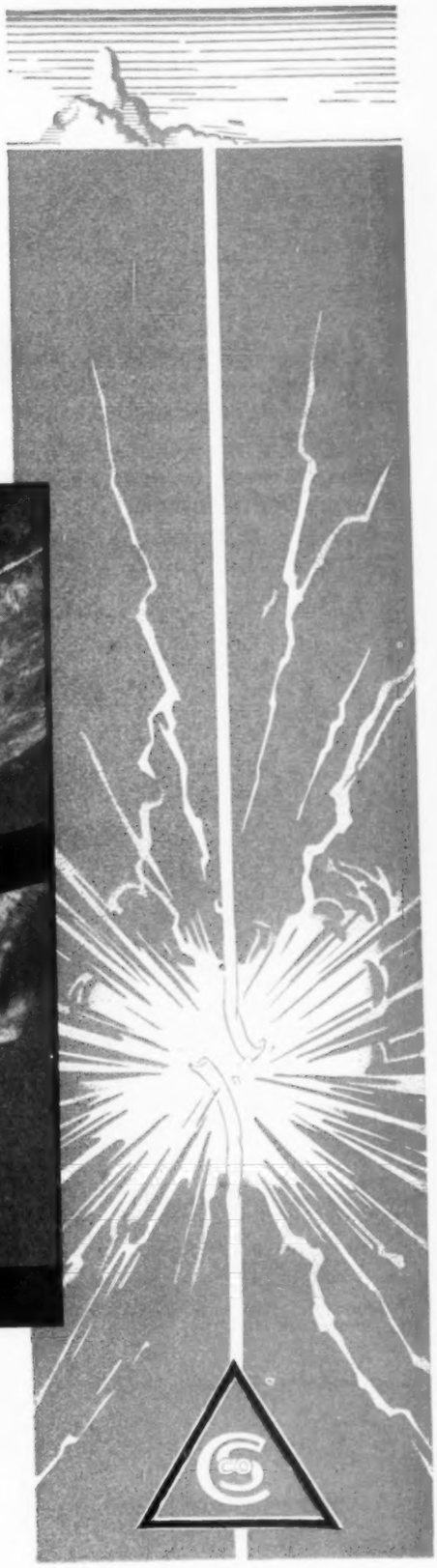
Fig. 8

DYNAMITED!

but the weld did not open

ANOTHER PROOF THAT YOUNGSTOWN PIPE IS GOOD PIPE





These illustrations show sections of 1-inch tubing from a string that was hung in a well and had to be shot out. After the shot this pipe was drilled on in an effort to clear the hole. The sections taken out were badly mutilated but the weld did not open except at the extreme ends. » » »

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Diesel Engine Crank Shaft Alignment

By J. B. HARSHMAN
Sinclair Pipe Line Co.

AS the crankshaft of the Diesel engine is one of the most costly of all replacement parts, its alignment cannot be guarded too carefully.

Crankshaft failures can most invariably be traced to misalignment, except in very remote cases where a failure is due to a flaw in material.

Torsional strains are known to have caused failures after years of service, but the percentage from this source is relatively small if proper alignment of shafting is maintained.

A great many shafts break in the web or crankpin of the cylinder next to flywheel end of engine. This is usually due to misalignment of outboard bearing. This bearing carrying a great percentage of the weight of the flywheel naturally wears down more rapidly than the main bearings in the engine, causing a deflection of the shaft on the flywheel end.

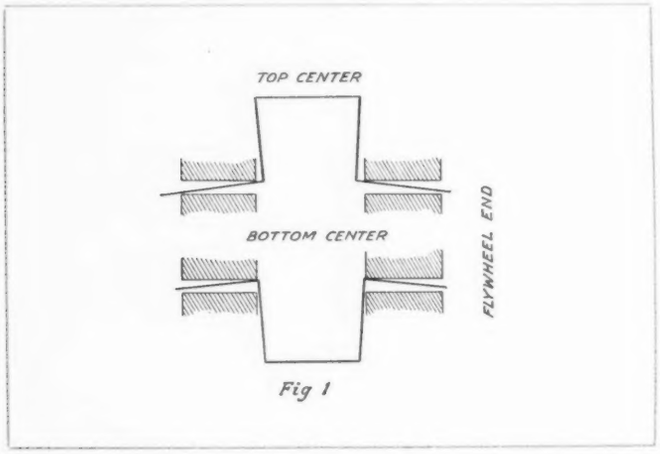

Fig 1

Figure No. 1 shows a typical condition where an outboard bearing has been permitted to run low, leaving the crank webbs close in the top center position and wide in bottom center position. The same condition would exist on inner and outer center if outboard bearing were out of line sidewise. Also this deflection can be found in the other crank throws of the engine if the main bearings are not in proper alignment.

When the engine is in operation a constant bending of the shaft takes place with each revolution, which in time crystallizes the metal, causing failure of the shaft at the point of greatest stress.

These stresses can be removed from all engines having three or more main bearings, allowing the shaft to free itself of all stresses except its natural torsional strain, thus greatly prolonging the life of the shaft.

Figure No. 2 shows an exaggerated diagram of a two-throw crankshaft in opposite positions.

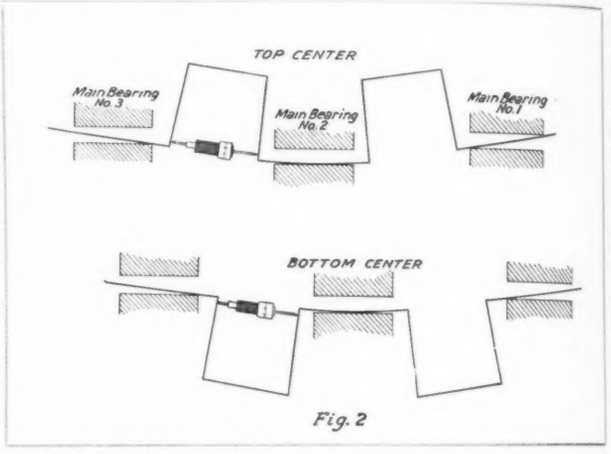

Fig. 2

Using a pair of inside micrometers to measure between the crank webbs in opposite positions one gets a greater measurement on top center than on bottom center which indicates that bearings number one and three are too high and must be lowered to allow the shaft to straighten out, making the measurement the same in both positions. These measurements should be made to check within .001 inch limits. This procedure should be followed out on each crank in the entire engine.

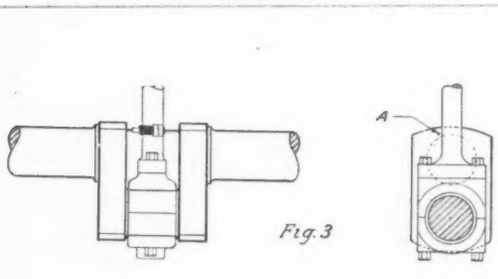

Fig. 3

In figure 3 is shown the spotfaced point "A" in the web of the shaft to insure measuring in the same point each time. This spot is made with a small drill of the proper size to allow the end of the micrometer to rest in the hole when taking measurements.

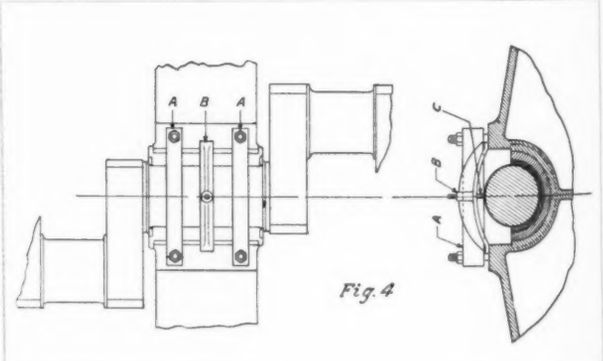

Fig. 4

The use of a bridge gauge as shown in Figure 4 is very valuable to determine the high and low bearings and to keep the shaft as nearly parallel as possible to the top surface of the bed plate.

The main bearing caps are removed and bridge gauge "B" is set in place with the point "C" coming directly over center of shaft. Measurements are taken between this point and top of shaft with feeler gauge. Another measurement is then taken with the parallel clamps "A" over the shaft, pulling the shaft down into the bottom bearing shell as far as possible. The difference between these two measurements is recorded and compared with the other bearings.

This method when used with the webb measurements gives one a double check on the shaft and insures greater accuracy.

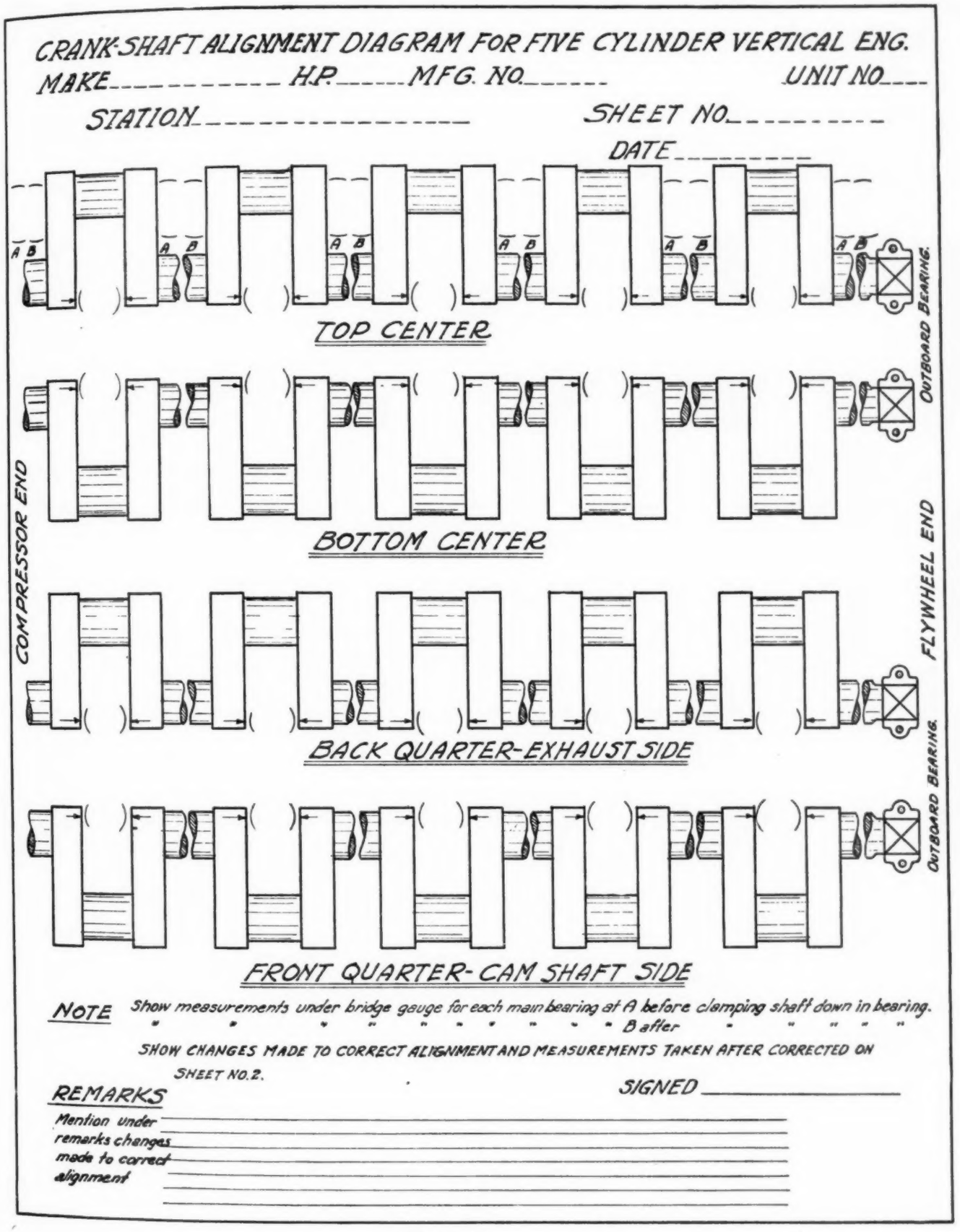
CRANK-SHAFT ALIGNMENT DIAGRAM FOR FIVE CYLINDER VERTICAL ENG.
MAKE_____ H.P._____ MFG. NO._____ UNIT NO.___
STATION_____ SHEET NO._____
DATE_____
A B
TOP CENTER
BOTTOM CENTER
COMPRESSOR END
OUTBOARD BEARING.
FLYWHEEL END
BACK QUARTER-EXHAUST SIDE
OUTBOARD BEARING.
FRONT QUARTER-CAM SHAFT SIDE
NOTE Show measurements under bridge gauge for each main bearing at A before clamping shaft down in bearing.
" " " " " " " " " B after " " " " "
SHOW CHANGES MADE TO CORRECT ALIGNMENT AND MEASUREMENTS TAKEN AFTER CORRECTED ON SHEET NO. 2.
REMARKS
SIGNED _____
Mention under remarks changes made to correct alignment

Fig. 5

Fig. 5 shows a complete diagram for recording the alignment of shaft for future reference. Many crankshaft failures could be avoided if this method were used during the installation of the engine and at least semi-annually thereafter.

THE TAYLOR SAFETY

PATENT

Figure 1

The Taylor Safety Casing Spider is the last word in automatic Spiders. It is properly designed and sufficiently strong to handle the longest known strings of casing. The body of the Spider is a one-piece, box type steel casting. The slips are also made of cast steel and are cored and ribbed to reduce unnecessary weight to the minimum.

Figure 1 shows the complete Spider with slips in closed or gripping position. Note the arrangement of the operating mechanism, it is housed within the body of the Spider safe from damage. This arrangement eliminates all obstructions above the slips, which allows the elevator to be lowered on top of the slips without danger to the operator or mechanism. The slips are heat treated and hardened, and are beveled at top and bottom to prevent coupling hanging on slips while casing is being raised or lowered.

Manufactured by

OKLAHOMA IRON WORKS

TULSA, OKLAHOMA

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CASING SPIDER

No. 1650101

Specifications

Size of Spider	10″
Weight of complete Spider with one set of slips	2580 lbs.
Length of body	76″
Width of body	23″
Extreme width (over lugs)	36″
Height with slips raised	26½″
Height with slips lowered	17½″
Height slips raise	9″
Length of slips	16″
Clearance between coupling and slips with slips raised	1¾″

The 10″ Taylor Spider will accommodate slips ranging in size from 10¾″ down to 4¾″.

Figure 2

Figure 2 is a view with the slips in raised position and the cover plate removed to show the lever mechanism employed in raising and lowering the slips. All these parts are made of steel and are designed to withstand the hard abuse this class of equipment must endure. The slips are held in contact with the bowl of the spider by means of dovetail keys that are rigid enough to permit the Spider to be used in place of back-up tongs whenever the string of casing is sufficiently heavy to prevent the pipe turning in the slips. To change slips it is necessary to only remove the two pins attaching lifting arms to slips. Slips can be easily changed in a few minutes, either by hand or with the aid of a lifting hook furnished with each Spider for this purpose.

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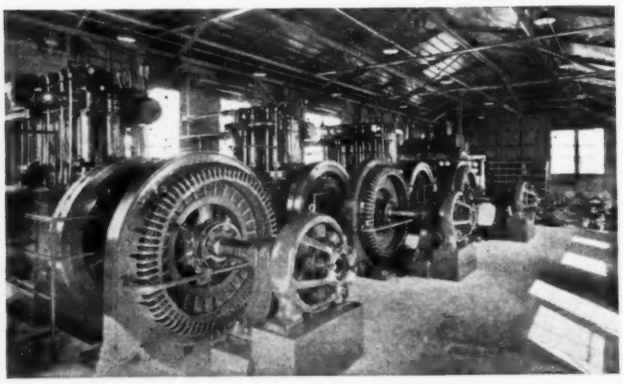
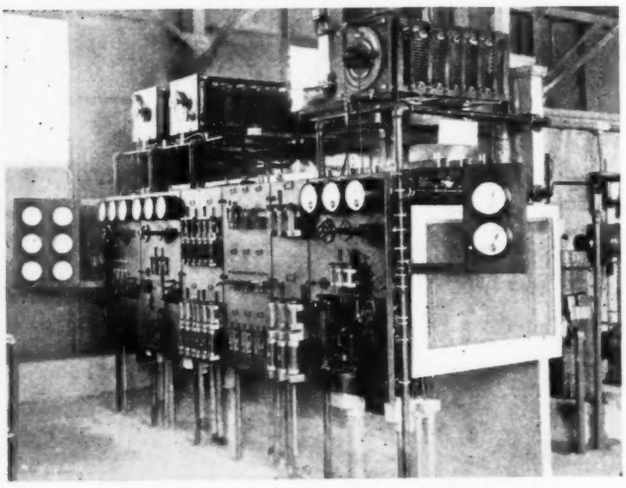
In Louisiana Field

Dixie Gulf Has Ideal Gas Line Station

ONE of the ideal gas compressor stations in the Northwestern Louisiana area is the Dixie Gulf Gas Co.'s 4,800-horsepower compressor station at the terminus of the company's main line, which extends to Houston and Port Arthur, Texas. The plant is located just over the Louisiana line at Waskom, Texas, and was placed in operation in January, 1929. It gets its gas supply from the several fields in Northwestern Louisiana and an additional supply from the Monroe and Richland fields in Northwestern Louisiana.



Auxiliary power plant.



Switchboard in auxiliary power plant.

This station is admirably located in surroundings which have been made for excellent landscaping by the station crews. In the two years it has been in operation, excellent care has been taken of the grounds and in the springtime, when flowers are blooming, it is one of the company's show places.

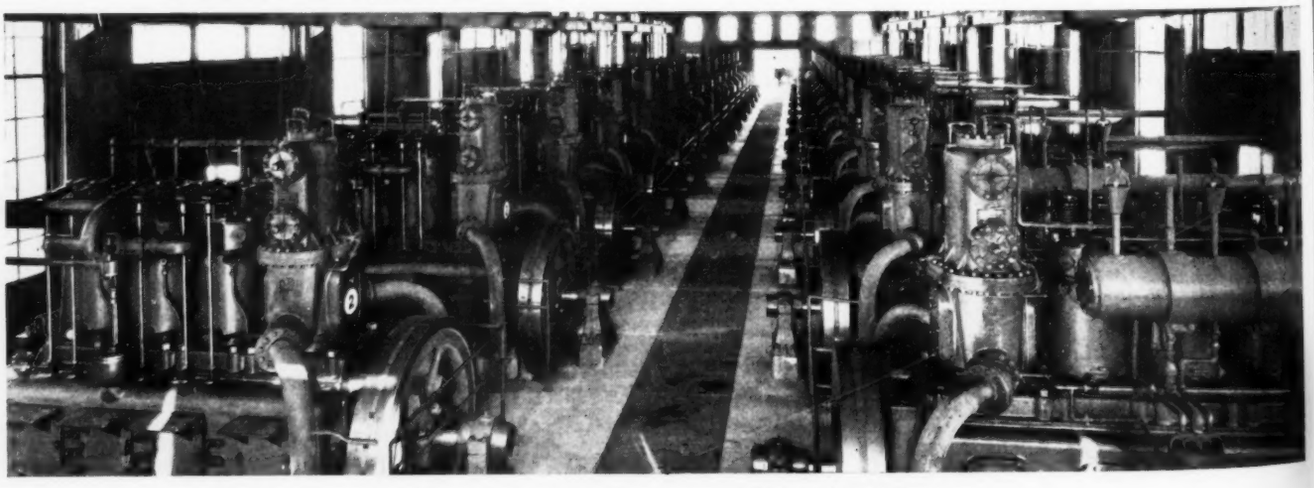
Waskom station is powered with 30 160-horsepower vertical gas compressors. Four of the compressors are operated on the low stage side and 26 on high stage, and all are equipped with bi-plane valves. The plant's intake pressure ranges from 100 to 125 pounds and the discharge pressure from 325 to 350 pounds. The maximum capacity of the station is placed at 80,000,000 cubic feet of gas daily.

The auxiliary power plant at Waskom handling the pumps, lighting system, etc., is powered by two directly connected 137.5-K.V.A. A. C. generators and one 187-K.V.A. A. C. generator directly connected to an engine. The air compressors used in starting the engines are driven by electric motors, and these compressors are used to flow the low capacity water wells at the stations.

The safety work of the station is something in which every employee has taken a great pride. Many contrivances to promote safety have been worked out and installed at the Waskom station. The results of the company's safety campaign are well demonstrated in the reports for the past 18 months, which show that not a single employee has been injured to the extent that the services of a physician were required.

One of the features of the station's operation is the absorption type gasoline plant which strips the gas before it is moved on south. The plant was completed along with the compressor station, both being ready for operation at the same time. As many automatic features as were practical were called for in the specifications when the plant was built. All of its machinery is driven by electric motors, with exception of the boiler feed pumps. One of the circulating water pumps has a capacity of over 1,000 gallons per minute. The plant has six high-pressure bubble type absorbers and its rated capacity is 100,000,000 feet of gas daily.

Grade AA gasoline is manufactured and transported to a loading rack one and a half miles distant through a welded line by means of a pressure tank located at the plant.



Interior of Waskom compressor station of Dixie Gulf Gas Company.

Cuts it *right in the middle*

Drillers find that after the Guiberson Four-Disc Reaming Rotary Bit has penetrated soft and semi-hard formations and intervening rock shells, it has also cut something else, and that's *drilling time*, right in the middle. Pete Green, Driller at Oklahoma City (the man with the hat on, behind the Disc Bit in the photograph), used this bit down to 3500 feet, and reports that it "required about half the usual time." Prepare for plenty of cuttings, put on the Guiberson Disc Bit, head 'er down and let 'er go!

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BETTER BE SAFE THAN SORRY

Tideland Location Responsible for Many Operating Difficulties at Elwood Terrace

IN common with practically all oil fields, Elwood Terrace in California is unique. Its claims for uniqueness are: Many difficult and costly derrick installations, prolific high gravity oil production, part of which underlies the Pacific Ocean, independence of vehicular or pipe line transportation due to proximity of navigable water, and orderly development and production programs.

As may be noted from the accompanying photographs, "Build the derrick!" is a much larger order on a tideland permit than the same order when given to a land-lubber rig-builder at a location more distant from the briny waters. In fact, it is one of the few cases where more time and money is spent preparing the location for a derrick than is spent in drilling and completing the well.

FIG. 6
Pier construction in progress at a tidelands well, Elwood Field, Calif.

FIG. 5
Well on the tidelands, Elwood Field, California. Note the automobile track on the beach and the ramp connecting the beach and pier.

Due to a misunderstanding and oversight, the owner of the lease down to the mean tide line refused permission for the tideland operators to travel on their premises. This necessitated anchoring a steamship loaded with pier and derrick equipment as near the shore as possible. Steel beams were used for piling in constructing the piers. These were unloaded from the steamship onto a smaller boat which, after anchoring near the pier, was also unloaded by a derrick barge. By the aid of a long crane, the derrick barge moved the steel beams to the pier, where the piledriver could then drive them solidly into the shale which underlies the beach sand. In making the location the engineer (standing below the mean tide line regardless of temperature or breakers) then madly gesticulates until the piledriving crew moves the pile to where it will line up with the cross hairs of the transit. The building of the pier continues inward toward the shore until only sufficient room is left for a roadway between the derrick and the mean tide line. Naturally, heavier supports are used at the ends for the support of the derrick corners.

FIG. 3
View showing part of the development on the water front at Elwood Field, California.

The pier is built long enough so that should conditions warrant it another derrick may be built on the oceanward end. Steel cross braces are welded to the piles. Electric welding is generally used and leaves little doubt that the welder has the most difficult job of all. Salt water spray from incoming breakers keeps their working place continually damp, if not drenched. The continued electric shocks, although not severe separately, are trying on the nervous system when prolonged over a period of time. It is not unusual to see a welder coming off tour twitching so that he might be suspected of having palsy.

Upon completion of the pier, the regular derrick and drilling equipment, consisting of engine, pumps, rotary table, wire lines, boilers, drill pipe, cas-

FIG. 1
Seagoing rodman about to descend to the ocean floor. He reports his observations to a man at the surface through a speaking tube.

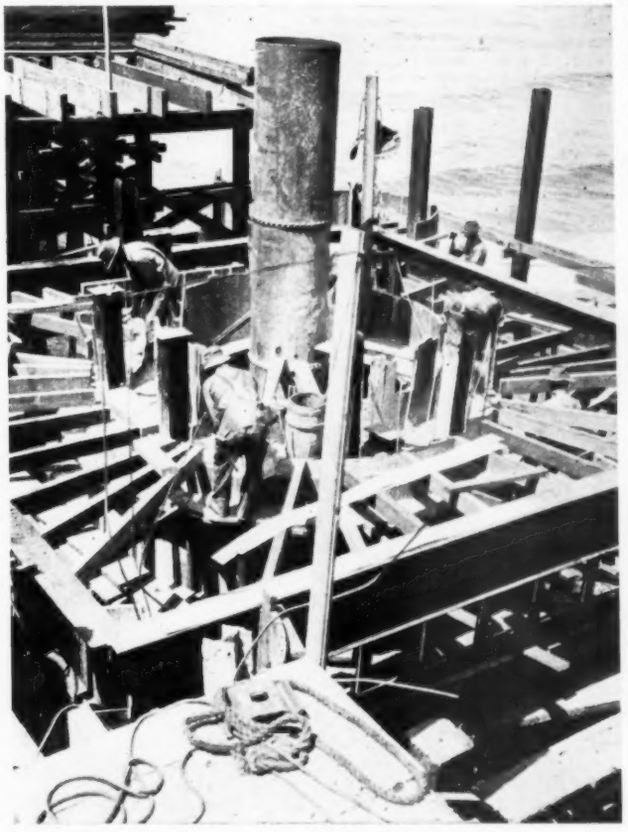

FIG. 4
Cellar construction under way on a tidelands well at Elwood Field, California. Note the surface conductor casing around which the work is being carried on.

ings, etc., are removed from the steamship to the pier. Unfortunately, the horses or steam shovel cannot compete in digging the slush pit, since tanks for that purpose are also brought in over the water. The settling ditches are ingeniously laid around the derrick in a manner to secure the longest travel with the allowable drop in elevation. After the material is unloaded, the steamship, which has been patiently standing by for three or four months with a full crew on board, at a cost of several hundred dollars a day, is free to pull anchor and look for new cargo.

The cost of completion of the pier and first derrick is approximately $50,000.00, while the cost of drilling and completing the well is in most cases less than $35,000.00. Production from the wells varies from 1000 to 5000 barrels or more of 35° to 40° A. P. I. gravity oil from an average depth of 3500 feet. Gasoline plants are operating profitably on the casinghead gas which is produced at considerable back pressure in an effort to comply with the new state gas conservation law.

FIG. 2
Pier under construction. Piledriver and long crane on barge are shown at the right of the picture.

There are now over twenty producing wells in the field. A recent completion was the Barnsdall-Rio Grande No. 11 Luton-Bell, which was allowed to flow naturally and made 3000 barrels of 37° gravity oil per day for five days while the potential production was being determined for the next curtailment period.

The accompanying photograph gives a few hints on the proper attire for a seagoing rodman who wishes to determine the attitude of the formations without waiting for the drill to tell him whether their location is running high or low. Ordinarily an experienced diver is employed for the exploration work, so there is no danger to the geologist unless he becomes unduly exasperated in telling a layman through a speaking tube what information he considers vital.

Towers of International Renown

The Leaning Tower of Pisa, being thirteen feet off perpendicular, became first a continental, then an international curiosity. Eiffel Tower, spearing skyward for almost a thousand feet, has long had its hold on our imagination. And Washington Monument is internationally recognized as a strictly American symbol in architecture.

The Exchange National Bank building would be dwarfed by comparison if placed beside that Parisian structure of steel. But in the banking and financial affairs of the oil industry the Exchange National has risen to superior heights because of a broad, helpful policy of service and a progressive attitude.

The Exchange National Bank has not confined its encouraging influences exclusively to oil. Yet it is so definitely identified with the history of Mid-Continent development that in the southwest, in the nation and beyond national borders the Exchange National is regarded as a tower of financial strength in the oil industry.

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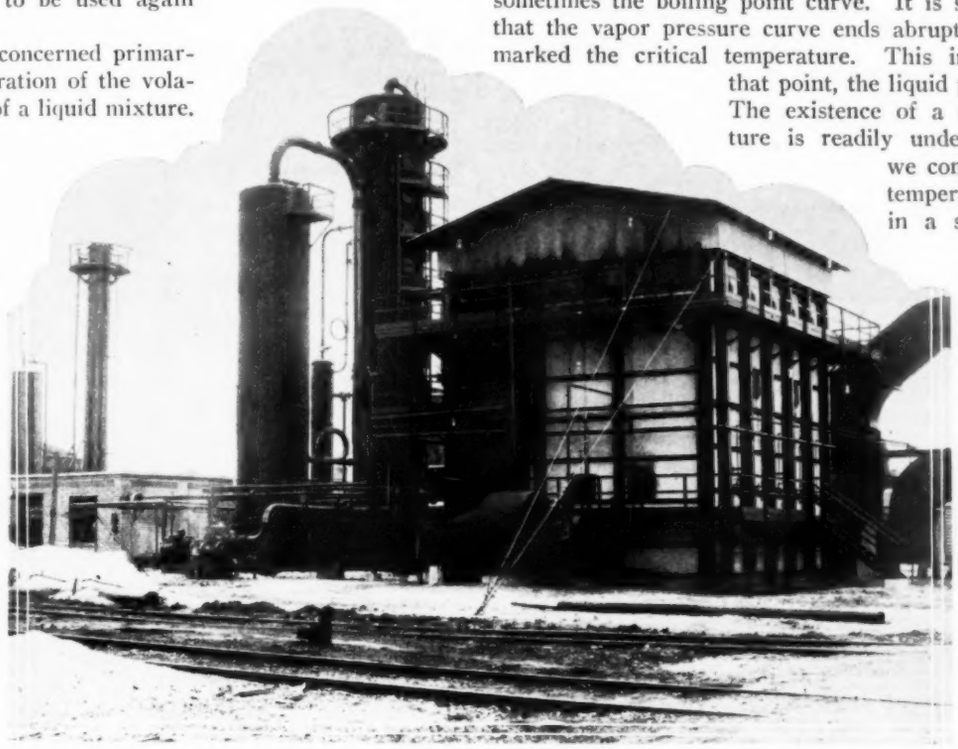
Elementary Principles *of* Distillation

By PROF. RAYMOND ABEL

VAPORIZATION of liquids is the basis of the three great technical processes of Drying, Evaporation, and Distillation. Although these processes in their industrial applications merge into one another, the field of application of each is pretty well defined. Each of these unit processes of engineering has equipment peculiar to it and radically different from that employed in the others.

Drying normally refers to those processes in which a relatively small amount of a valueless liquid, usually water, is removed from a solid or liquid material. Evaporation refers to the removal, by vaporization, of large quantities of a liquid, usually water, from solution. In both Drying and Evaporation, the distillate is of little importance in comparison to the residual material. The distillate is recovered only when it is to be used again in the process.

Distillation is concerned primarily with the separation of the volatile constituents of a liquid mixture. In it, recovery of the distillate is most important. The residual material may or may not be of value. Its applications range from simple separation of water from dissolved salts, in making of distilled water, to the isolation of individual hydrocarbons from petroleum.



Six-thousand-barrels-daily pipe still, Winkler & Koch.

A clear understanding of the mechanism of distillation processes, therefore, necessitates a knowledge of the vaporization and other thermal characteristics of liquids.

We recognize three distinct states of aggregation in which a substance may exist. These are the solid, liquid and gaseous phases.

Considering a system in which a pure substance, say water, exists alone, the relation between the solid, liquid, and gaseous or vapor phases as affected by temperature and pressure may be shown by the equilibrium diagram, Fig. I. It is a typical phase diagram for a system in which only one component, for instance, water or octane, is present. In the region S, only the solid phase is stable; in region L, only the liquid phase can exist indefinitely, and in region V, solid or liquid would eventually pass into the vapor state. Line ON represents the series of temperatures at which the solid and liquid phases can exist in equilibrium with each other. For most substances this line slopes upward to the right because they contract upon solidifying. For water, as the diagram indicates, and a few other substances, which expand upon freezing, increase in pressure tends to keep them in the denser liquid state. Line O M represents a series of pressures and corresponding temperatures at which the solid passes directly into the vapor state upon heating. Below the point O, the liquid is an unstable phase; at O, all three phases can co-exist.

For our purposes, the line O P which expresses the equilibrium between the liquid and the vapor phase is the most important. It is termed the vapor pressure curve; sometimes the boiling point curve. It is seen from Fig. I that the vapor pressure curve ends abruptly at a point P, marked the critical temperature. This indicates that, at that point, the liquid phase disappears. The existence of a critical temperature is readily understandable when we consider that as the temperature increases in a system composed of liquid and vapor in equilibrium, that is along line O P, the density of the liquid, which is only slightly affected by pressure, increases, while the density of the vapor under the fast mounting pressure increases rapidly. A point P is finally reached where the liquid and vapor are of the same density and are indistinguishable, one from the other. Above this temperature, the substance can exist only in a gaseous state, no matter how much pressure is exerted upon it. It is a permanent gas. Ordinarily, no distinction is made between the vapor and gaseous state. Strictly speaking, a substance is a gas when it is above its critical temperature, a vapor when it can be liquefied by pressure alone.

The critical temperature is a very important consideration in the liquefaction of gases, obviously, a gas must be cooled below its critical temperature before it is possible to liquefy it. Table I shows critical data on a number of important gases and liquids. The critical pressure, Fig. I, is the vapor pressure of the liquid at the critical temperature. It is seen that the critical temperatures of the atmospheric gases are

very low. Nitrogen must be cooled to 233° F. before it can be liquefied by the application of pressure, alone. Obviously, in the cracking of petroleum, many of the hydrocarbon compounds present cannot be kept in the liquid state at the cracking temperatures employed no matter what pressure is used on the system. For instance, to maintain pentane in the liquid state, a temperature less than 387° F. would have to be used.

In present-day steam power plant practice, water is subjected to a pressure above its critical (3190# in^2) and changed into steam without boiling by heating it beyond the critical temperature 705° F. before expanding it for use.

Vapor pressure is so important a property of liquids in any process involving vaporization and condensation that it merits further discussion at this point.

A body of liquid can be conceived as made up of countless particles called molecules, each having the distinctive chemical properties of the mass. These molecules are in ceaseless motion, which is intensified by rise in temperature. The mutual attraction of the molecules opposes this motion. At a given temperature, the molecules have a certain average velocity. Some of the molecules have a velocity above this average, others below.

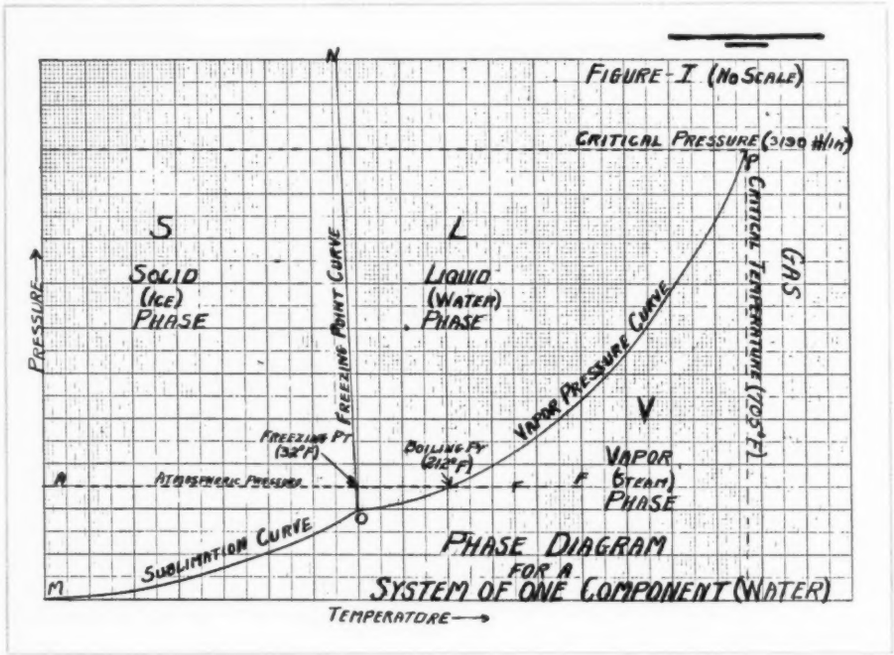
If now the liquid is placed in an evacuated vessel held at constant temperature, those molecules that have a higher velocity than the average will, on reaching the surface, escape from the liquid and fill the space above. As the number escaping from the liquid increases the vapor becomes denser and more and more molecules will be attracted again into the liquid until finally a point is reached where the number returning is the same as the number leaving the liquid and a state of equilibrium between the liquid and vapor exists.

The vapor state differs decidedly from that of the liquid. In it, the mutual attraction of the molecules is slight and they move in straight lines until they collide with one another or the walls of the vessel. The collision with the walls of the vessel is measured as a pressure exerted upon them. When equilibrium exists at any temperature this pressure is the vapor pressure of the liquid at that temperature. The vapor pressure, therefore, measures the tendency of the molecules to leave the liquid. If the temperature of the liquid is increased, the liquid expands, reducing the mutual attraction of the molecules, the liquid molecules increase in average velocity, they leave the liquid more rapidly and the vapor pressure rises.

Since the vapor pressure is the measure of a phenomenon that is similar in all liquids the law relating vapor pressure and temperature is the same for all liquids. The simplest form of this law is $\log P = \frac{K}{T} + C$ where P is the vapor pressure at the absolute temperature T; K and C are constants depending upon the particular liquid and the units of temperature and pressure used. This form is sufficiently accurate for most engineering calculations. A more accurate form of this equation is used in the preparation of steam and ammonia tables.

Figures III and IV show vapor pressure curves for heptane, octane and water. They illustrate how rapidly the vapor pressure increases with temperature. For instance, the vapor pressure of octane at 100° F. is about 29 mm. of Hg and at 200° F. it is 290 mm. They also show how slowly the boiling point of a liquid decreases with decrease of external pressure. Nonadecane, $C_{19}H_{40}$ for instance, at 760 mm. boils at 626° F. and at 10 mm. boils at 352° F.

For many liquids of importance in petroleum distillation only a few points on the vapor pressure curve have been determined. Figure V illustrates a commonly used scheme of determining the vapor pressure curve in such cases. In the Duhring Chart, water or some other liquid for which an accurate vapor pressure curve is available is taken as a standard. If the temperature of the substance corresponding to a certain vapor pressure is plotted against the temperature at which water has the same vapor pressure, the points plotted will fall on a straight line. Since a straight line is determined by two points, only two vapor pressure determinations for a substance are needed in order to construct its complete vapor pressure curve from the Duhring Chart. The example in Figure V illustrates the method of reading the chart. It is required to determine the vapor pressure of decane at 400° F. Following the 400° F. line from the bottom upward to the line marked decane and then to the left, we find that its vapor pressure at 400° F. is the same as that of water at 258° F. From steam tables this is found to be 1768 mm. It is often convenient to lay off the vapor pressure scale alongside of or in place of the temperature scale in order to avoid the use of steam tables.



In Figure I, line A F shows the changes of state that occur when heat is applied to the substance at atmospheric pressure. It does not, however, indicate the amount of heat involved in the changes of temperature and of phase. These are shown in Figure II, where the heat content of water in B.t.u. per lb. during the change taking place along A F is plotted against the temperature. At both the freezing and the boiling point the temperature remains constant during the change of state, while the heat content increases considerably. Since the slope of the line A B shows the amount of heat required to raise the temperature of the solid, one degree, it is the specific heat of the solid. Likewise, C D and E F are the specific heats of the liquid and vapor, respectively.

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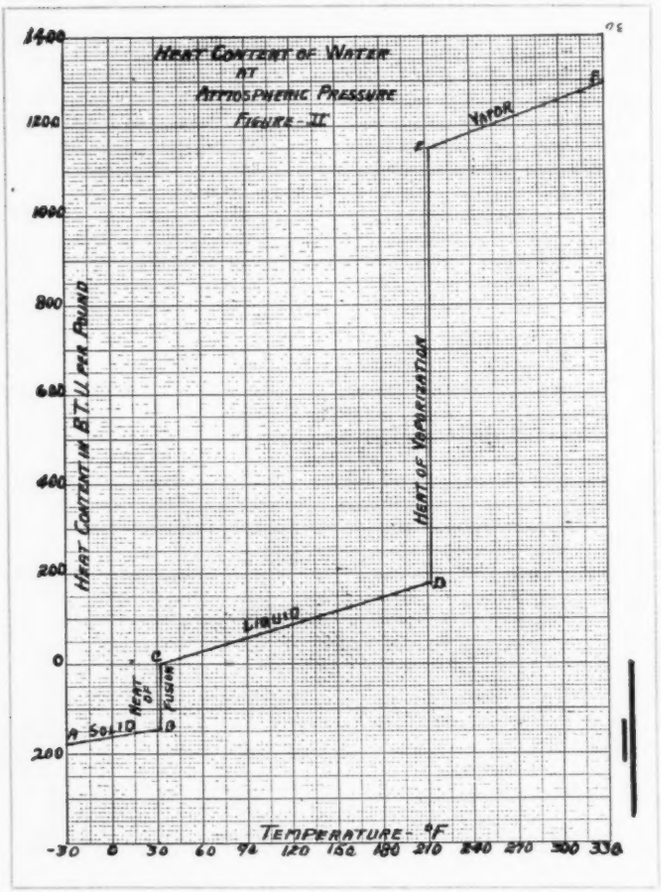


Thus far we have considered the vaporization of liquids in the presence of their own vapors only. What effect does an inert gas, such as air, have upon the equilibrium between a liquid and its vapor? We know from Dalton's Law of Partial Pressures that in the case of a mixture of gases the total pressure is the sum of the individual pressures exerted by the constituents. In the case of a liquid vaporizing into a gas which, under the conditions obtaining, is not very soluble in the liquid, then the same relation holds. The partial pressure of the liquid will be its vapor pressure at the temperature employed. Thus, if a closed vessel containing liquid octane with air above it is maintained at a constant temperature, the octane will vaporize until it produces a pressure equal to its vapor pressure. Say the final conditions are such that the total pressure is 900 mm. and the temperature 150° F.; then the partial pressure of the octane would be 99 mm., its vapor pressure at 150° F. The per cent by volume of the octane in the

$$\frac{99}{}$$

vapor space would be $900 \times 100\% = 11\%$. In changing this to weight per cent, we apply one of the most important generalizations of chemistry—namely, Avogadro's Hypothesis. This states that under the same conditions of temperature and pressure, equal volumes of all gases contain the same number of molecules. This furnishes the basis for an important chemical unit, the molecular weight. The weight in pounds of a substance that will occupy the same volume as 32 pounds of oxygen is the molecular weight of the substance; at 32° F. and 1 atmosphere pressure this volume is 359 cu. ft. The molecular formula of a substance shows its molecular weight. Thus the molecular weight of oxygen is 32' of octane, 114. The molecular weight of a substance expressed in pounds is called a pound mol.

Per cent by volume, then, is the same as molecular per cent. The vapor space in the above illustration contains 11 mol. per cent of octane. From this the weight per cent can be readily calculated.

Distillation processes are concerned with the separation of the volatile constituents of liquid mixtures. Careful experimental studies of the characteristics of liquid mixtures has been made only in the case of binary liquid mixtures—that is, those containing but two components.

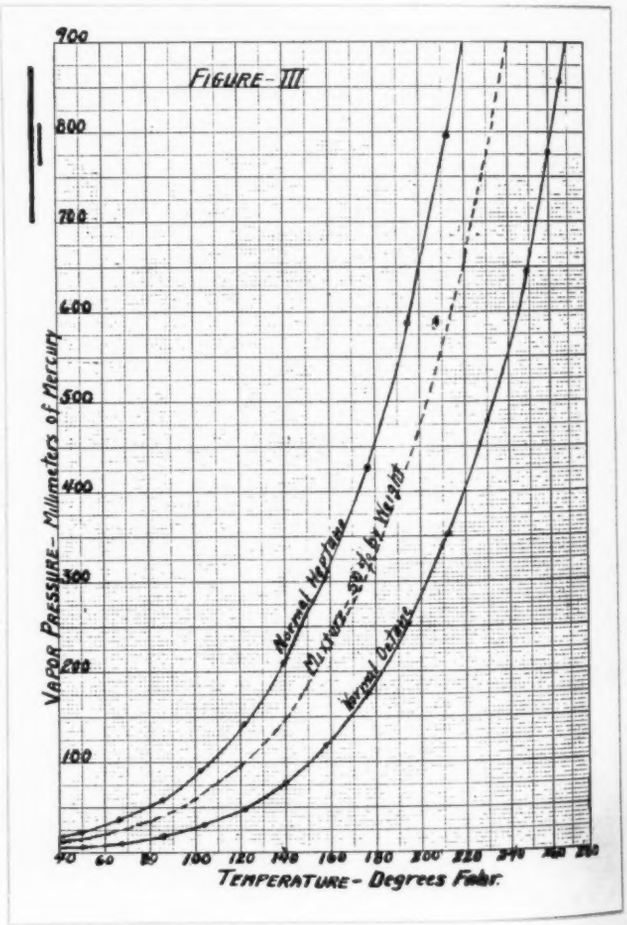
Three classes of binary mixtures occur:

(1) Mixtures of immiscible liquids, in which the constituents are insoluble in each other.

(2) Mixtures of partially miscible liquids.

(3) Mixtures in which the constituents are miscible in all proportions.

A mixture of octane and water, Fig. IV, is an example of a binary liquid mixture made up of insoluble constituents. Each exerts its vapor pressure independent of the other and the relative amounts of each distilling off at equilibrium will depend upon Dalton's law. If the total pressure Po + Pw is 760 mm., the two will distill in the proportions indicated by the equation $\frac{Wo}{Ww} = \frac{PoMo}{PwMw}$ where Wo is the pounds of octane distilling with Ww, pounds of water; Po and Pw the vapor pressures of the two, and Mo and Mw their molecular weights. Distilling at atmospheric pressure, we have Wo + Ww = 760 mm., which corresponds to a boiling point of 193° F. At this temperature the vapor pressure of water is 507 mm.; of octane, is 253 mm. Then $\frac{Wo}{Ww} = \frac{253 \times 114}{18 \times 507} = 3.16$ pounds of octane in the vapor per pound of steam. These, of course, are the conditions obtaining in the steam distillation of petroleum, except that



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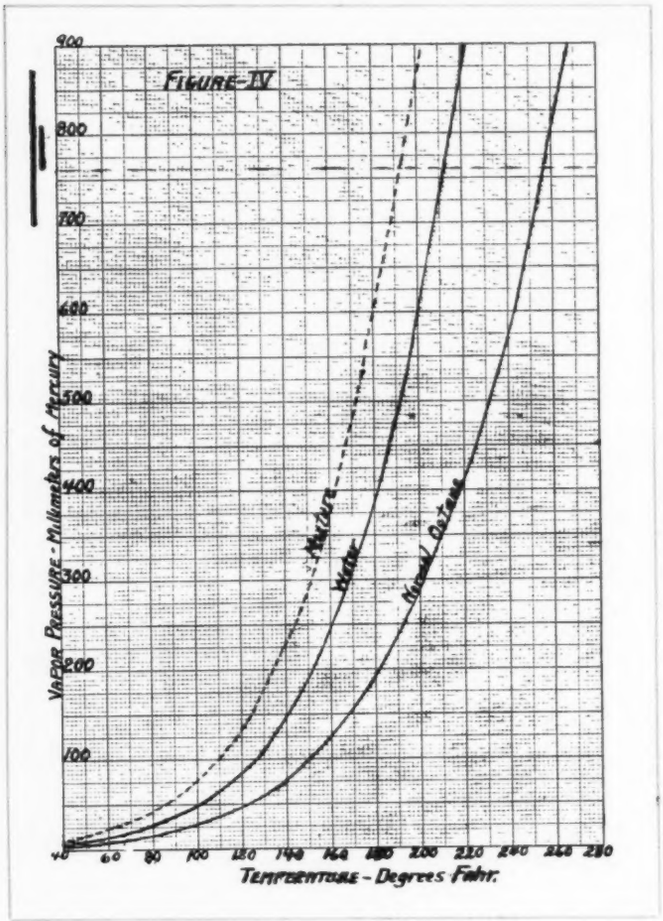


they are complicated by the presence of numerous instead of one hydrocarbon.

The effect of steam is indicated when we consider that the mixture boils at 193° F., while octane at the same pressure boils at 256° F. This is of importance in the distillation of oils that decompose below their boiling points. Where the steam distillation is carried on at higher temperatures and water is not present in the still, then the equation becomes $\frac{Wo}{Ww} = \frac{PoMo}{(P-Po)Mw}$ where P is the external pressure.

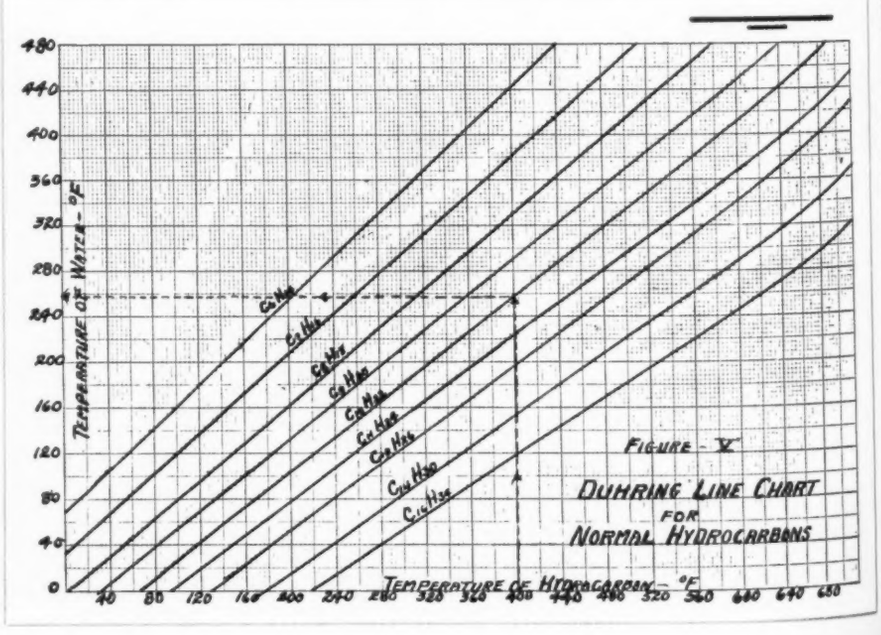
In refinery practice, distillation with steam is used in two distinct ways. In steam stills where naphthas are distilled with steam, a water layer is present and conditions represented by the case of octane and water exist. In distillation of heavier fractions in fire and steam stills, steam is employed to reduce the effective pressure on the still and permit heavy oils to distill over below their normal boiling points. The theoretical amount of steam needed in such distillation can be calculated from the second steam distillation equation.

In the steam distillation of heavy oils the steam has several important effects. It is introduced through perforated pipes which gives it a high velocity and causes it to be broken up into small bubbles. These agitate the oil and, in the case of shell stills, keep portions of the oil from overheating by preventing continued contact with the fire sheet of the still. A large surface of evaporation is presented by the numerous small bubbles, which causes the composition of the vapor more nearly to approach the ideal equilibrium value. Instead of the usual liquid surface from which evaporation takes place, the increased surface causes more rapid evaporation.

Partially miscible liquids are relatively unimportant compared to the other two classes and will not be discussed in detail here. Ether and water at ordinary temperature form such a system. As ether is added to water, the vapor pressure of the mixture increases until about 7% ether is added. At this point the water is saturated with ether and two layers, one, ether saturated with water, the other, water saturated with ether separate out. These remain in equilibrium with each other over a wide range of composition until about 97% ether has been added. Over this range the vapor pressure is constant. Beyond this point the water is completely soluble in the ether. It is evident that two liquids may be completely miscible, partially miscible, or immiscible, depending upon the temperature.

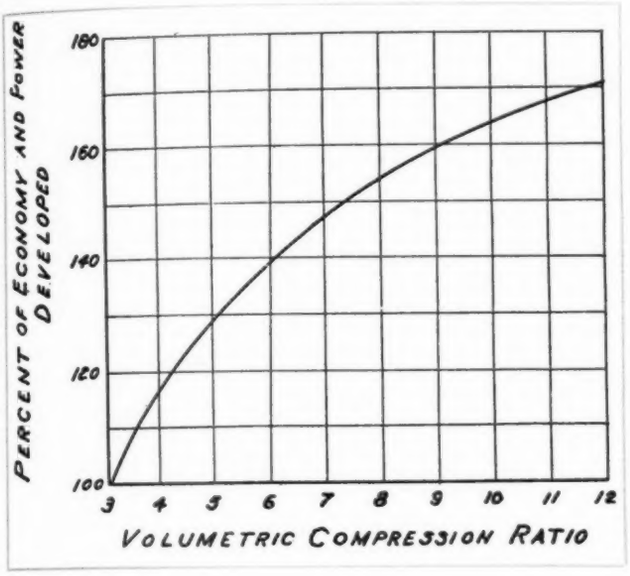
The class of binary liquid mixtures in which the constituents are miscible in all proportions holds the greatest interest for petroleum technologists. Three cases arise in this class: (a) Mixtures in which the vapor pressure always lies between the vapor pressures of the pure constituents. Case I in Figures VI and VII show the relation between boiling point, vapor pressure and composition for such mixtures. (b) Mixtures in which a minimum boiling point occurs at a certain composition as shown in Case II of Figures VI and VII. (c) Mixtures in which a maximum boiling point occurs at some composition as illustrated in Case III of Figures VI and VII. It will be noted that the maximum and the minimum points on the boiling point curves, Figure VII, occur where the vapor and liquid have the same composition. These are constant boiling point mixtures whose constituents cannot be separated by fractional distillation alone.

The boiling point composition curves of Figure VII are of interest because of the relation between the composition of a liquid mixture and that of the vapor given off from it under conditions of equilibrium. Case I, where the mixture boils between the boiling point of its pure components, is the condition obtaining in the case of petroleum hydrocarbons with few known exceptions.



Modern Engineering Principles *of* Combustion Engines

NO phase of the evolution of civilization is more interesting than that of man's efforts to increase his productivity by the utilization of Nature's combustible resources, and the story of these romantic adventures becomes all the more interesting when it is considered that almost all engines, both the external and internal combus-



tion types, have been evolved in a comparatively short time. Although both steam and internal combustion engines were invented only a relatively short time ago, the history of the real internal combustion engine dates back as recently as the latter part of the 19th century.

There is a remarkable similarity in the development history of steam and internal combustion engines. Steam engines for a long period employed saturated steam at relatively low pressure. Eventually the advantages of superheating were recognized, but phenomenal progress was not made until a comparatively few years ago. Now large central power generator stations are using pressures of 1200 pounds per square inch or over in addition to superheating, reheating, and regeneration. Modern metallurgical and fabrication methods have permitted the construction of boilers and turbines which withstand the pressure and erosive action of high pressure, superheated steam and the possibilities of future development can scarcely be predicted.

Progress in the design of steam power plants required a careful analysis on paper of the possibilities of high pressure superheated steam together with reheating and regeneration. Progress in internal combustion engine design requires a similar thermodynamic analysis of cycles, efficiencies, pressures and temperatures. It is difficult to predict the future except in terms of the past, hence a brief review of the past history of engines should aid in the prediction of design trends of the future.

Serious consideration of the internal combustion engine did not begin until the middle of the 17th century. The cannon was really the first internal combustion engine and for more than one hundred years inventors endeavored to develop a gunpowder engine. Inflammable gas was not used until 1794. In 1860, Lenoir of France built the first commercially successful gas engine. So great was the demand for this type of power plant that within five years four hundred of these engines had been sold in France and one hundred in England.

The Lenoir engine employed no pre-compression of the gaseous charge. As the piston moved away from dead center, inflammable gas was drawn into the cylinder. At the completion of about one-third of the stroke, the intake valve closed and the charge was fired by an electric spark. Expansion could be carried down to atmospheric pressure, but on account of the absence of compression, the efficiency and output of the engine were very low. Fig. 1 shows the theoretical indicator card from an ideal Lenoir engine. The line 0-1 represents admission, 1-2 explosion, 2-3 expansion and 3-1 exhaust. Assuming a heating value of 1000 B.t.u. per pound of charge, the maximum possible expansion ratio, obtained when expansion is carried down to atmospheric pressure, is only 5.93 to 1 and the efficiency 38.0%, whereas the efficiency of the ideal Otto cycle, the cycle universally used in automotive engines, at 6 to 1 compression ratio, is 51.16%. The latter cycle will be considered later.

It was not until 1862 that the advantages of pre-compression of the charge were realized. In that year, M. Beau de Rochas formulated four conditions which he considered essential to high efficiency:

1. Maximum ratio of cylinder volume to exposed cylinder surface.
2. Maximum piston speed.
3. Highest possible pressure at beginning of expansion. (This necessitates highest possible compression ratio.)
4. Greatest possible expansion.

These four conditions are yet generally recognized as essential to high efficiency except that the tendency of fuels

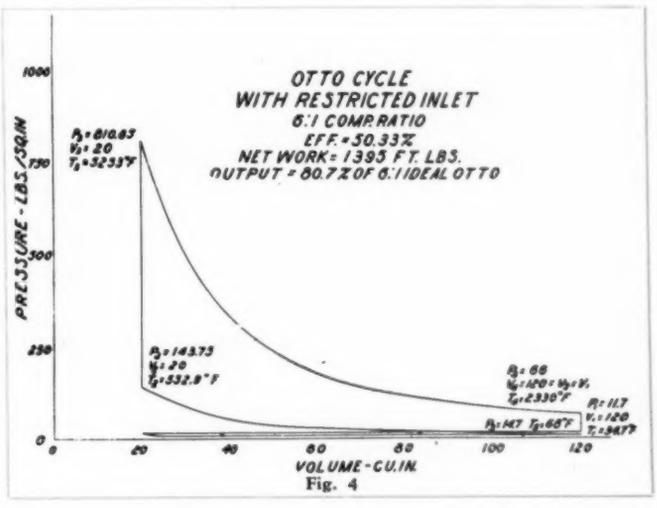


Fig. 4

to detonate may make possible the realization of a higher efficiency in an engine with smaller ratio of cylinder volume

to exposed cylinder surface. The possible efficiency is complicated by a number of factors.

For a number of years the attention of automotive engineers was not focused upon the development of greater power, but upon the development of those accessories which would result in more reliable operation. When materials and mechanisms had been developed to the point where uninterrupted operation could be relied upon, the motoring public clamored for something better than a glorified horseless carriage and the race for increased power was begun.

The desire of the public for greater speed, acceleration and flexibility under all conditions has not yet been satisfied. Neither have the possibilities of internal combustion engines

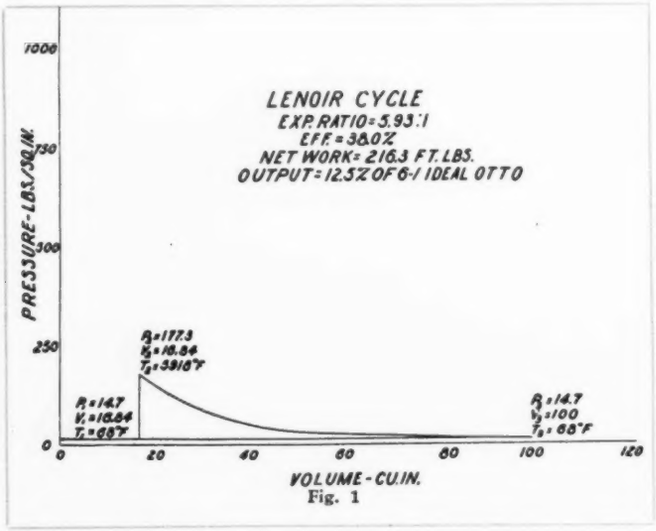


Fig. 1

been exploited to anything approaching their ultimate limit. We may safely believe that in the not distant future the public will demand performance obtainable in no car today with a fuel consumption very materially less than that of present day cars. While it may be expected that everything possible will be done to increase the cyclic efficiency, it is reasonable to believe that improved alloy steels and nonferrous metals will permit a reduction in the weight of engines per horse power which will, in turn, be reflected in added performance and increased economy.

Computation of Engine Efficiency

It is appreciated by all engineers that an accurate prediction of actual thermal efficiencies of engines on the basis of theory alone is almost impossible, due to the large number of variables which influence the efficiency of a given engine. A combination of experience and thermodynamic theory, however, permits an exceedingly accurate prediction of the performance of any engine even before it has been built.

A large number of data are available on the performance of internal combustion engines of all types and sizes. If the performance of a given engine at a given compression ratio is known, experience has indicated that its performance at other ratios of compression may be calculated quite accurately by a consideration of air cycle efficiencies for similar conditions. The actual thermal efficiency of an engine at two different ratios of compression is in almost exact proportion to the thermal efficiency of ideal air cycles of the same compression ratios. For example, a certain Otto cycle engine at 5 to 1 compression ratio is known to have an output of 75 h. p. and its probable output at 6 to 1 compression ratio is desired. The thermal efficiency of an Otto air cycle at 5 to 1 compression ratio is 47.47%, while the efficiency of the same cycle at 6 to 1 compression ratio is 51.17%. The ratio of the latter to the former is 1.078. The 75 h. p. output of the actual engine at 5 to 1 compression ratio may be multiplied by 1.078 to determine the probable output of the engine at 6 to 1 compression ratio. This is found to be 80.46 h. p.

Naturally, the thermal efficiency of ideal air cycles is always higher than that of real engines. Imperfect combustion, wire drawing of the charge through the induction system, work required to expel the exhaust gases, heat losses to cylinder surfaces during combustion, friction and other losses contribute to the difference between actual and theoretical thermal efficiency.

A number of ideal cycles have been prepared to illustrate various possibilities of engine improvement. Although the thermal efficiency in all cases is higher than is actually possible in practice, the information is valuable if only ratios of efficiency and not absolute values are considered.

Inasmuch as the methods used in the preparation of the charts may be of interest, the equations used are given herewith. (Refer to the ideal Otto cycle 6 to 1 compression ratio, Fig. 2.)

The displacement for each cycle was made 100 cubic inches. The initial pressure and temperature of each cycle were assumed to be 14.7 pounds per square inch and 68 degrees Fahrenheit, respectively; k, the exponent of adiabatic compression and expansion, and R, the gas constant were assumed to be those for air, 1.4 and 53.34, respectively. The lower heating value of fuel-air mixture is, on an average, approximately 1000 B.t.u. per pound. Although only air was considered as being taken into the cylinder it was assumed to have a calorific value of 1000 B.t.u. per pound.

Inasmuch as the compression ratio of the cycle of Fig. 2 was assumed to be 6 to 1, the clearance volume was made one-fifth of the displacement volume. The clearance volume plus the displacement volume gave V_1 which with P_1 and T_1, which were assumed, gives all the information required

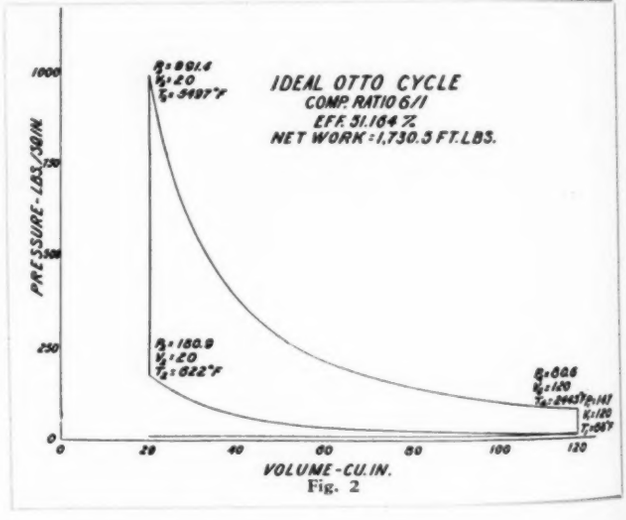


Fig. 2

concerning the starting point. The compression curve is plotted from the equation $P_1V_1^k = P_2V_2^k$ and this equation gives the value of P_2.

From the equation $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ the value of T_2 is obtained.

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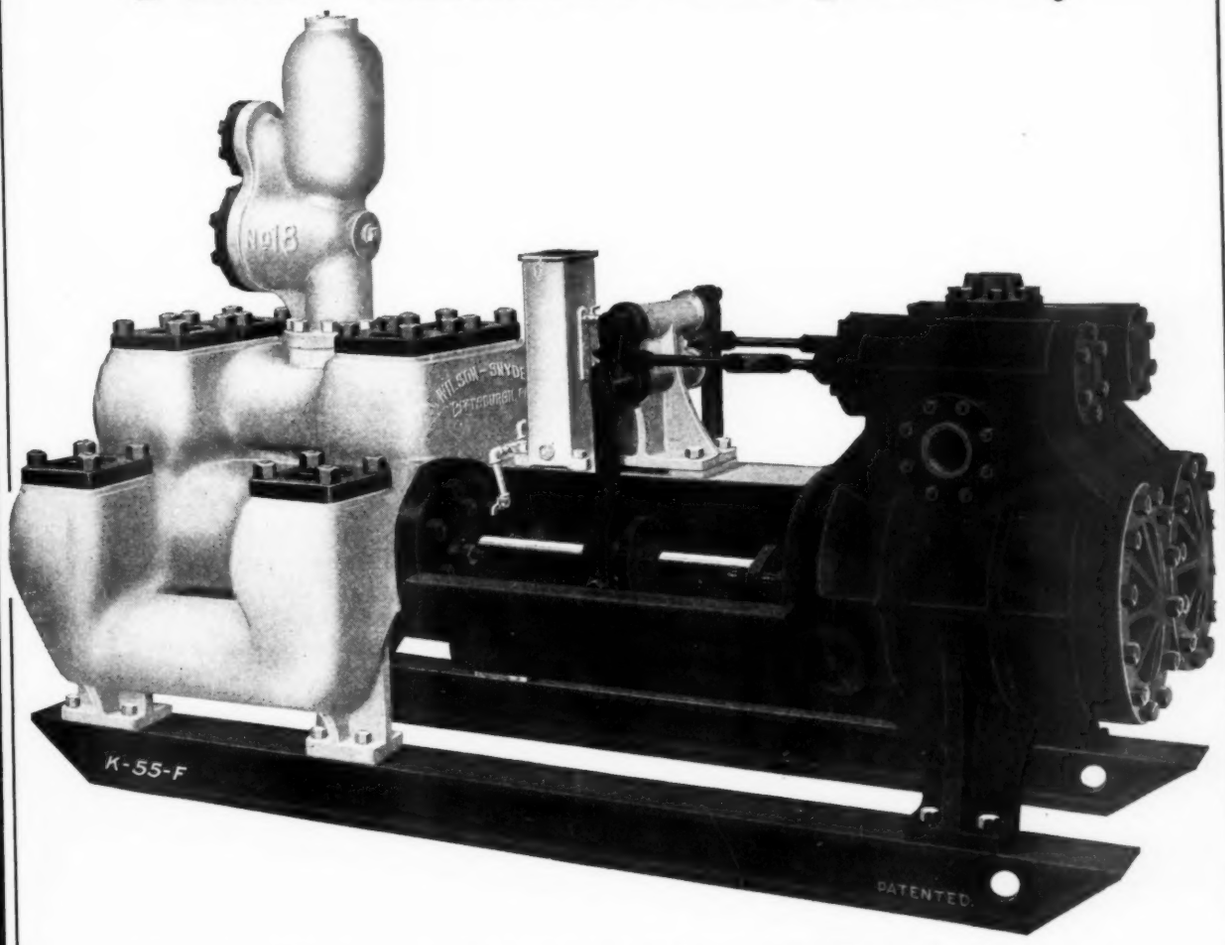

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The values of c_p and c_v were assumed to be those for air, 0.241 and 0.171, respectively.

The heat added at constant volume during combustion is $1000\ W_c = W_t c_v (T_3 - T_2)$ in which W_c is the weight of fresh charge and W_t is the total weight of gas compressed. From this equation the value of T_3 may be found.

A solution of the equation $\frac{P_1 V_1}{T_1} = \frac{P_3 V_3}{T_3}$ gives the value of P_3.

The expansion curve is obtained by plotting the equation $P_3 V_3^{\,k} = P_4 V_4^{\,k}$. This equation gives the value of P_4.

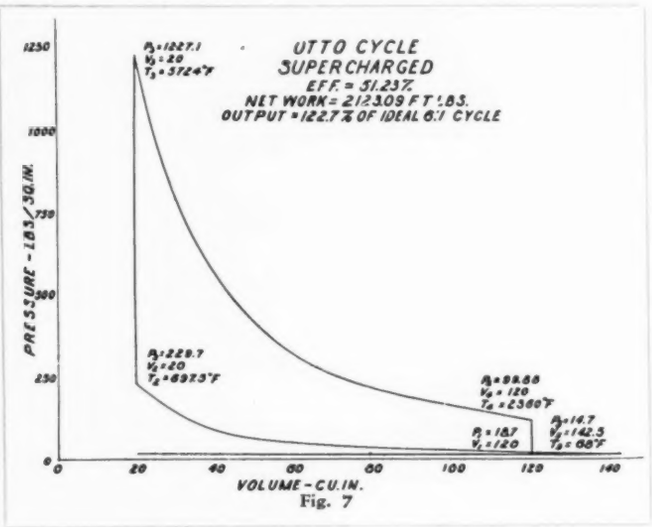


Fig. 7

The value of T_4 is found by solving the equation

$$\frac{P_1 V_1}{T_1} = \frac{P_4 V_4}{T_4}$$

The work under the expansion curve in foot pounds $= \frac{P_3 V_3 - P_4 V_4}{k-1}$ where P_3 and P_4 are in pounds per square foot and V_3 and V_4 are in cubic feet. Similarly, the work under the compression curve $= \frac{P_1 V_1 - P_2 V_2}{k-1}$. The algebraic sum of the work of compression and expansion is the net work of the cycle. The efficiency of the cycle $= \frac{\text{Net work in ft. lb.}}{777.7 \times \text{Heat added}}$ and also for the cycle of Fig. 2 $= (1-(\frac{1}{R})^{k-1})$ where R is equal to 6, the compression ratio of the cycle.

The Diesel cycles to be shown later may be computed in similar manner except that the heat is added at constant pressure instead of constant volume. For example in the Diesel cycle of Fig. 9, $1000\ W_c = W_t c_p (T_3 - T_2)$.

The Relation of Efficiency and Output to Compression Ratio

Fig. 3 shows the ratio of the efficiency and output of high compression Otto engines compared with the efficiency and output of an Otto engine of 3 to 1 compression ratio. It may be seen from the curve that the output and efficiency of an Otto engine of 7 to 1 compression ratio are 27.3% greater than the output and efficiency of a similar engine at 4 to 1 compression ratio.

High Compression Ratio Does Not Necessarily Mean Really High Compression Engine

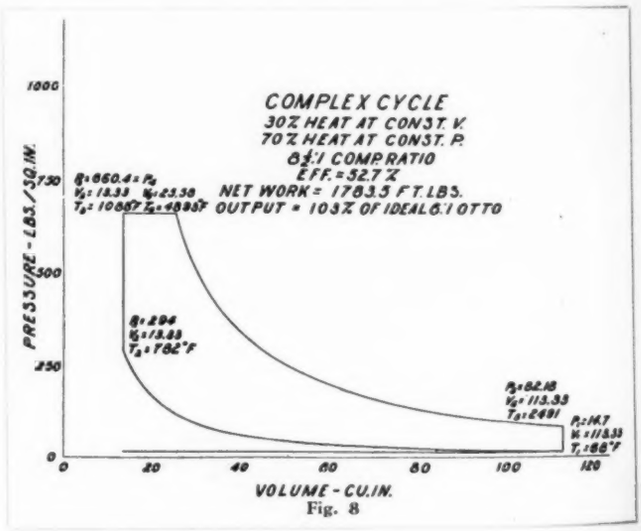
Numerous attempts have been made by automobile engineers to secure the benefits of high compression by designing engines to have a high compression ratio, but relatively low peak pressures, obtained in a number of ways. It has been stated previously that certain combustion chamber designs, by lengthening the time of burning, decrease peak pressures without causing a sacrifice in efficiency or economy. Other changes in design, however, introduce serious losses as may be seen by an examination of Figs. 4, 5 and 6.

Fig. 4 shows an ideal Otto cycle of 6 to 1 compression ratio with all conditions the same as those of Fig. 2 except that the pressure of the charge entering the cylinder is reduced 3 lbs. per sq. in. by the resistance of the induction system. The result is a reduction in output of 19%.

Fig. 5 shows another Otto cycle of 6 to 1 expansion ratio with all conditions the same as in Fig. 2 except that the closing of the intake valve does not occur until one-third of the compression stroke has been completed. The output of the ideal cycle engine is reduced 36% by the delayed closing of the intake valve. Although this design does not materially reduce the thermal efficiency of the Otto cycle, the actual brake thermal efficiency would be considerably reduced due to the larger percentage of the output of the engine which would be used in overcoming friction.

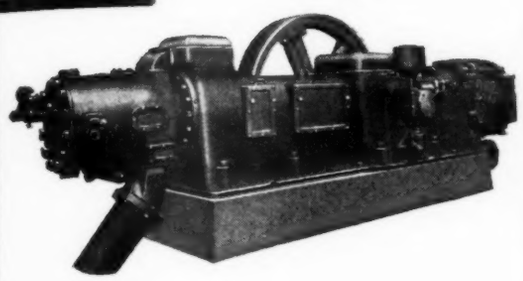
Fig. 6 shows another Otto cycle of 6 to 1 compression ratio. All conditions are the same as in Fig. 2 except that ignition occurs 15° late. The effect is to reduce fuel economy and output approximately 3.5%. The power loss in actual engines due to spark retardation is much greater.

Each of the expedients which has been used to suppress detonation in the last three cycles described is fairly effective. It will be noted that in each case the maximum pressure, as well as the maximum temperature of the cycle, has been reduced. In actual engines the percentage reduction of pressure, especially in the case of late ignition, would


COMPLEX CYCLE
30% HEAT AT CONST. V.
70% HEAT AT CONST. P.
8½:1 COMP RATIO
EFF. = 52.7%
NET WORK = 1783.5 FT LBS.
OUTPUT = 103% OF IDEAL 6:1 OTTO
PRESSURE - LBS./SQ.IN.
VOLUME - CU.IN.
Fig. 8

be greater than in the case of the ideal cycles which are described here and the suppression of detonation would, therefore, be even more effective. At the same time the percentage power loss in a real engine due to spark retardation would be higher. It is evident, therefore, that reduction of volumetric efficiency and retardation of ignition beyond that required for maximum power should not be

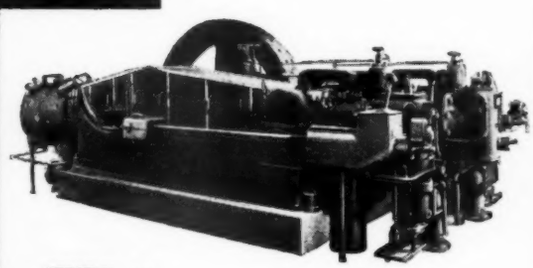
2 - CYCLE - OR



TYPE-10

Cooper-Bessemer gas engine or gas engine driven compressor unit in single and twin cylinders 95 to 200 B. H. P.

4 - CYCLE -



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resorted to in an effort to suppress detonation. It is much more satisfactory to use a lower compression pressure which permits the use of maximum volumetric efficiency and correct spark advance.

Supercharging

Much is heard about supercharging, but its real advantages and disadvantages are not so well understood. It has commonly been used on the small racing cars which have been entered in the Indianapolis races and on aeroplane engines. Superchargers, themselves, take various forms, but one of the most widely used is the Moss type which depends for its operation upon the pressure created by a small, high-speed, centrifugal blower. The greatest use for the supercharger today has been in the building up of manifold pressure at high speed in racing car engines or at high altitudes in aeroplane engines. The effect is to make the power curve of an engine practically a straight line instead of a curve with a sharp bend at high speed or at high altitude.

An examination of an ideal Otto cycle with supercharging such as the one shown in Fig. 7 discloses the fact that while the power output of a 6 to 1 Otto cycle is increased 23% by supercharging to a pressure of 4 pounds without intercooling, the thermal efficiency of the cycle remains practically constant. The same increase in output could be obtained by the use of a higher compression pressure on the regular Otto cycle with a resulting increase instead of decrease of economy. The relative efficiency and output of an actual supercharged engine would be less because this ideal cycle assumes that the supercharger is as efficient as the engine when the latter is acting as a compressor, which is never true.

A difficulty which besets the use of a supercharger on passenger cars is the practical impossibility of constructing supercharger rotors of sufficient strength to withstand the decelerating forces made necessary by the rapid deceleration of engines. No satisfactory means have yet been found for using a supercharger to increase the torque of an engine at low speed for acceleration or hill climbing purposes. Supercharged engines require a fuel of as high anti-knock value as engines whose compression ratio produces a compression pressure of equal value, another argument for the unsupercharged high compression engine. Due to mechanical difficulties the supercharger does not seem destined to occupy a very important place in the automobile industry although it will always be used on certain types of aviation engines.

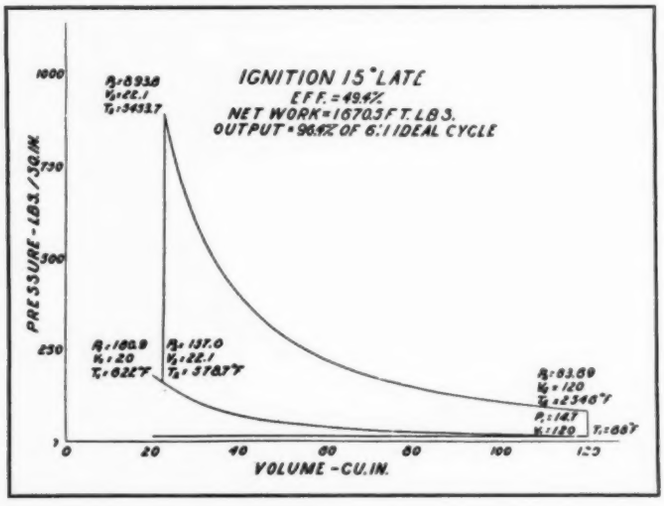

Fig. 6

Solid Injection Otto Engines

A number of designers are working on models which overcome the fuel loss by providing solid injection of the fuel near the end of the compression stroke. Due to the fact that, in some cases, the fuel and air do not form a homogeneous mixture in the combustion chamber in engines of certain types, the tendency to detonate is somewhat reduced, but whether the non-homogeneity of the mixture with its consequent slow burning will prevent the use of high speed at high brake mean effective pressure remains to be seen.

A considerable amount of experimental work is being done on engines having a so-called mixed cycle of the type shown in Fig. 8. In engines of this type a portion of the fuel, usually about 30%, is burned at constant volume while the remainder is burned at constant pressure. Some engines of this type have ignition systems while others depend upon the compression of the charge to effect ignition.

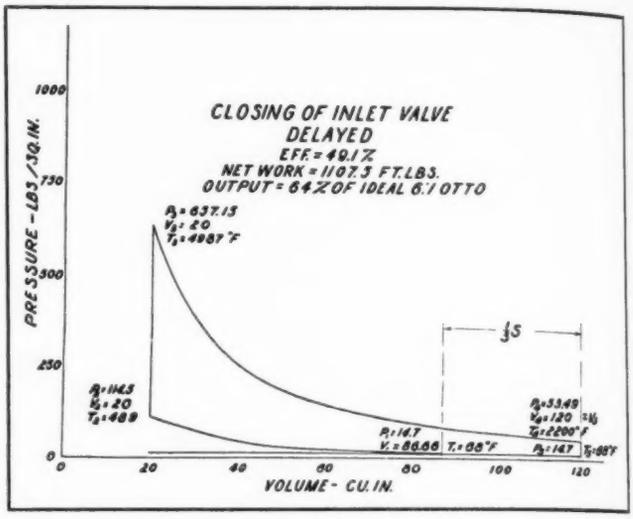

Fig. 5

Diesel Excavator Now Steam Shovel's Rival

EXCAVATORS powered with Diesel motors are giving steam shovels a race for business. Operators claim that not only are they easier to operate, but strain and breakage are avoided because intuitively they know when to stop if overloaded. The ability of the Diesel excavator to travel under its own power and to work with much less noise and fuss are regarded as added advantages, especially for city use.

In a recent test it was found that the average cost per yard of excavating with the Diesel motor was slightly more than 12c, as compared with 22c for the steam shovel. In excavating dirt, rocks and heavy roots the Diesel averaged 260 yards a day as compared with 175 yards for the steam shovel. The crew of the Diesel consisted only of two men, whereas five men were needed for its rival.

A four-page bulletin entitled, "Wire Cloth—All Meshes—All Weaves—All Lengths—All Widths—All Metals" has just been published by the Newark Wire Cloth Co., Newark, N. J. The bulletin shows a number of typical examples of wire cloth varying from 1 inch space to 300 mesh. It tells about their 400 mesh wire cloth said to be the finest in the world—160,000 square holes per square inch.

The rubber industry consumes 70 per cent of the carbon black produced in the United States.

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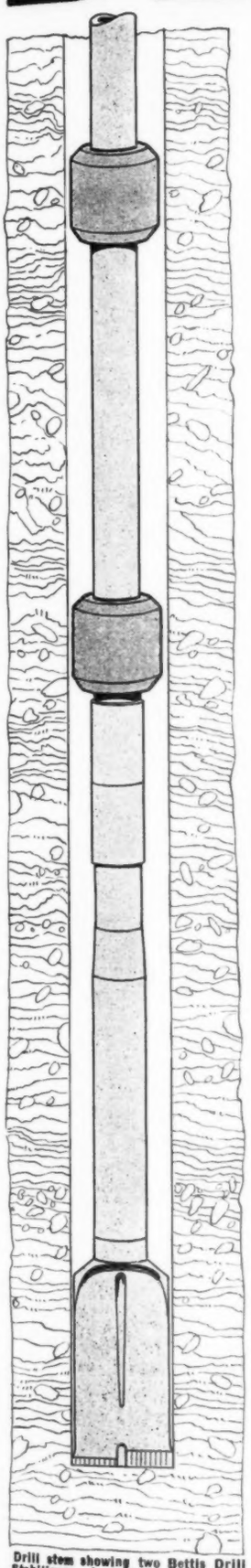
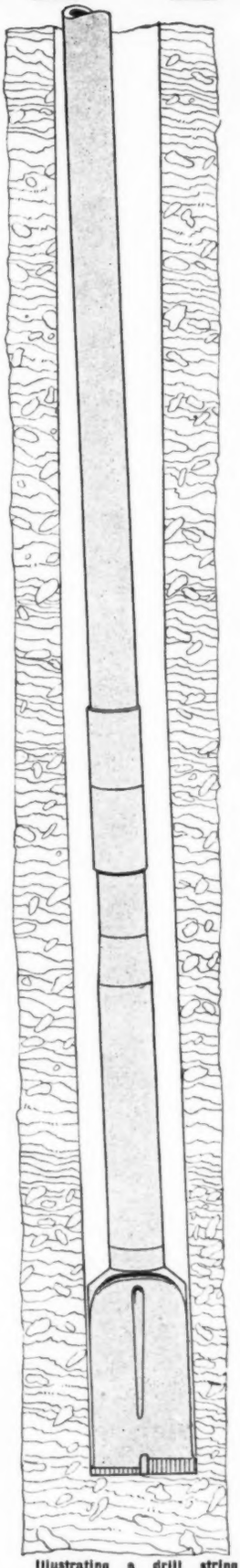


Drill stem showing two Bettis Drill Stabilizers in place, preventing wobble and excessive vibration of the drill and string.



Illustrating a drill string WITHOUT Bettis Stabilizer, encouraging twist-offs and crooked hole.

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Pressure Decline Methods Used in

Computing Gas Well Volumes

By C. P. PARSONS

This subject has a vital relation to conservation of the nation's resources. Mr. Parsons, though now engaged in oil well cementing and development of drilling fluids, is interested in this subject as he was the originator of the pressure decline plan for gauging gas well capacities, as used in the Chickasha Gas Field.—Editor.

A YEAR ago there was considerable discussion among oil men about eliminating the regular blowing of gas wells to take open flow readings.

The movement has been awaiting the results of a study being made by the Bureau of Mines toward making a plan in such form that it could be universally adopted. Such a study is exceedingly involved and is requiring a vast amount of work.

In order for all to better understand the results when such a plan is finished and to be in a better position to put it into effect, it seems that in the meantime discussion should continue.

Just one year ago a pressure decline method of determining gas well capacities was adopted in the Chickasha Gas Field by the Magnolia Petroleum Company with permission of the Oklahoma Corporation Commission. Since then several other companies have been using it.

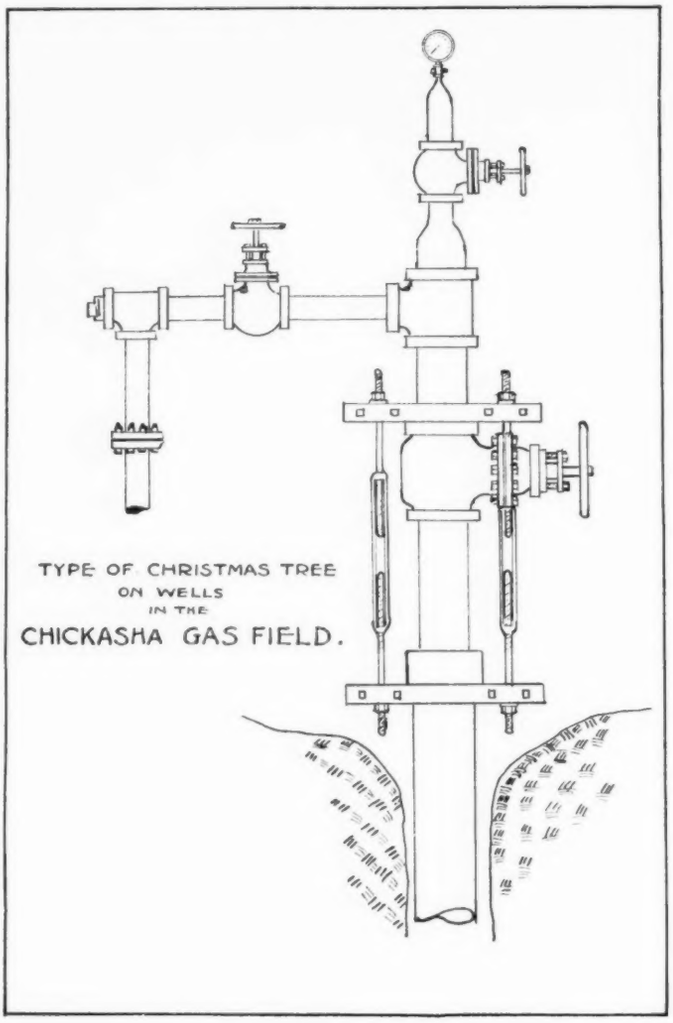
The primary purpose of the plan was to eliminate the necessity of regularly blowing gas wells into the air to get periodical open flow volume readings. There are other advantages besides saving a tremendous amount of gas. They also are important, and include the holding of back pressure on the sands at all times, which, by holding back the salt water, keeps the wells from drowning prematurely. Also it keeps more intact the exposed formations in the wells.

The plan has already been described in several articles and it is intended to give here a brief summary of the operation of the plan during the first year of its usage.

After a year's trial, the plan has proven capable of accomplishing its purpose of making it unnecessary to open a normal gas well in the Chickasha Field for the purpose of determining its capacity to deliver.

The plan has been regularly used on ninety wells and for the purpose of checking the plan against actual open flow readings, two check-ups were made on 170 wells. The well capacities were figured under the plan and then the wells were actually blown. Each comparison showed almost identical results by the two methods. Comparison of wells as large as thirty million cubic feet showed less than a million cubic feet difference. When proportioned to the percentage of delivery, the net difference would be negligible.

There were no difficulties encountered during the year and no special engineering skill was required to make determinations. Any well that became wet due to the normal encroachment of edge water following withdrawal of gas for delivery, readily reflected its condition by a subnormal reading on the pressure gauge. The well would have been dead long before under the blowing method. The plan also made a considerable saving of labor and equipment during the year. To have made just one open flow reading by blowing the ninety wells on which the plan was used, would have required seven full working days for a motor truck with five men and heavy tools. Under the plan, one man in a light car easily accomplished the same thing in two days.



TYPE OF CHRISTMAS TREE ON WELLS IN THE CHICKASHA GAS FIELD.

Summing it up, there were thousands of dollars worth of gas saved, the useful life of the wells lengthened, edge water held back, equipment expense lessened and very dangerous manual labor eliminated on ninety wells.

Until such time as a universal shut-in procedure is determined, a great many more gas wells could easily be gauged by shut-in pressure methods.

There is considerable merit to the 90 per cent pressure gauge plan of the Indian Territory Illuminating Oil Company used on gas wells in the Osage area. In Louisiana considerable work has been done. Many more wells could be profitably and equitably shut in by the use of these methods.

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Humble Station Employs Special Methods

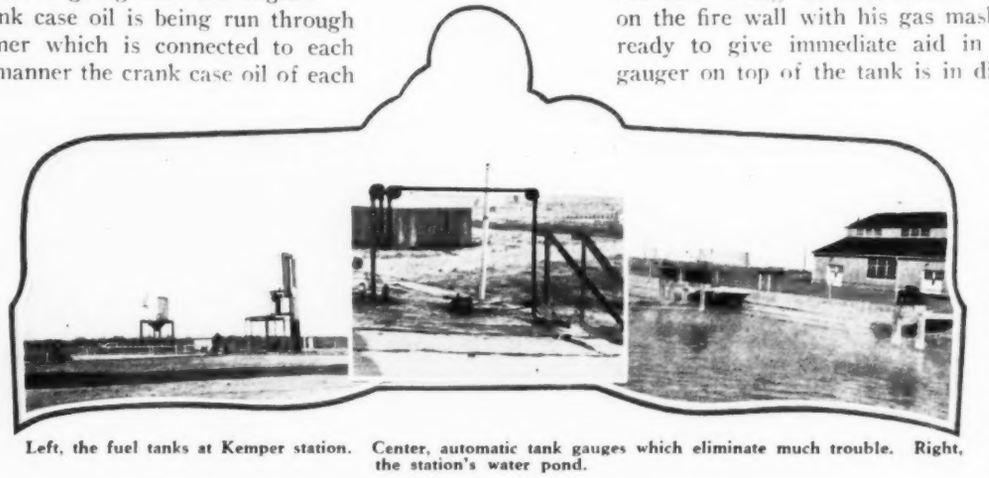
IN many respects the operation of a pipe line station in West Texas varies some from that of oil stations in other sections of the country, because of the problems peculiar to that oil producing region. Humble Pipe Line Co.'s Kemper station, about 12 miles east of the Big Lake Pool in Reagan County, has the largest capacity of any station in the West Texas area and in several instances is representative of the general plan of operation in the Permian basin area. All of the station buildings are constructed of steel and sheet iron, with concrete foundations, and the Humble Kemper plant is no exception.

H. H. Bryant

This station was built in 1925 and at that time was designed to handle 20,000 barrels daily. As West Texas grew, the station was expanded to 100,000 barrels daily capacity to handle the demands made upon the purchasers. Building up of the station's capacity was done gradually, and the enlarging of the building was a matter of adding sections to it. The present equipment includes four 165 horse power vertical Diesel engines driving four 10,000 barrel pumps; three 400 horse power vertical Diesels driving two 25,000 barrel pumps and one 27,000 barrel pump. Oil is pumped east through two 8-inch lines to connect with a main line at Comyn station and through a looped 12-inch line running south to seaboard at Ingleside Harbor on the Gulf Coast.

Because of the corrosive action of the sulphur oil which is used as fuel for the Diesels, the fuel lines of this station are all built of galvanized wrought iron. Two fuel tanks are used in order to give each day's fuel supply 24 hours' time for the water to settle out as much as possible and to be drained off before that tank is turned into the fuel line. All of the oil is being centrifuged at present and passes through filters before going into the engine.

All of the crank case oil is being run through a central reclaimer which is connected to each engine. In this manner the crank case oil of each unit is run through the centrifuge a few hours each week, and a surprising amount of foreign matter and water is removed. Before the oil goes into the centrifuge it passes through a heater. Through the arrangement of the piping system and the operation of valves, any unit can be connected with the centrifuge at any time.



Left, the fuel tanks at Kemper station. Center, automatic tank gauges which eliminate much trouble. Right, the station's water pond.

Kemper station does not have a fire wall and all of the pumps and engines are housed within the undivided floor space. The conduits for the piping system are covered with steel plates and drain into a sump.

The station is amply protected in case of fire, with small extinguishers and a general water and foam system. In a separate building, hose and other fire fighting equipment are kept ready for instant use, and are regularly inspected. In case of a fire, the foam mixer is moved to an advantageous point and connected to the line. In case of a failure of the pressure plant in the auxiliary house there is a gasoline motor driven unit in the small house containing fire fighting equipment. This emergency unit is connected to a pump and is used as a stand by, or can be used to build up more pressure in the water mains. The numerous fire hydrants on the station grounds are protected during the colder months from freezes by old oil drums filled with straw and placed over the hydrants. In case of a fire it is the duty of one man to remove the drum from the hydrant and have it in readiness by the time other members of the crew arrive with hose and the foam mixing chamber.

The presence of sulphur gas in quantities sufficient to overcome or kill anyone in direct contact with it, has brought about many safety features uncommon to usual pipe line station operation. In the early days of development in West Texas many gaugers lost their lives while working about tanks. It is the practice of Kemper station for the gaugers to work in pairs when making their rounds of the tanks twice daily. The hourly gauges are read from the automatic gauges on the tanks. Whenever the gaugers go out, the one going on top of the tank puts on his gas mask before climbing the tank ladder. Another stands on the fire wall with his gas mask available and ready to give immediate aid in the event the gauger on top of the tank is in distress.

In the station and manifold houses station crews are required to use the hose type mask whenever they are working in a close place. This type of mask has been found more satisfactory for this particular type of work where a gas hazard is present. All members of a station crew are well drilled in giving first aid in case a man is overcome by gas.

On the first tanks built at Kemper station, steel roofs were used and the breathers were located close to the head of the steps. When additional tanks were built they were constructed with wood roofs and the breathers located a considerable distance away from the head of the steps. Frequently the wind blew the gas from the breathers directly to the gauger at work over the hatch near the head of the steps. With the breather located farther away the wind carried away most of the gas before it reached the gauger, if it happened in his direction. At this station there is a walk leading from the fire wall to the steps of each tank. The walk built of steel frame work and planked.

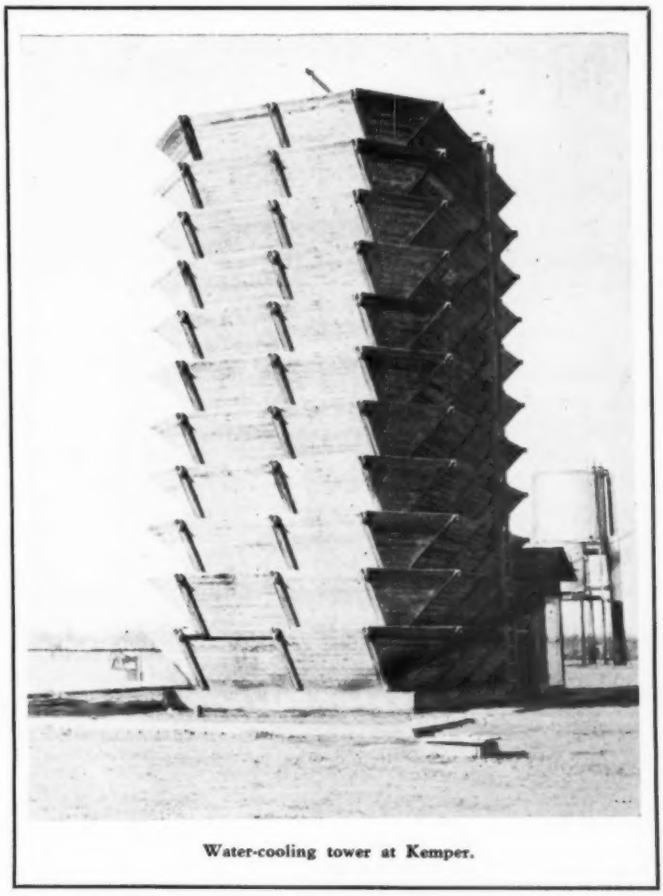
The automatic gauges operate with an aluminum chain attached to a wood or aluminum float in the tank, and to a graduated 36-foot steel tape, in tubing which extends from just inside the top of the tank, and over the side. The tape winds up on a spool which is enclosed, and a reading may be made through the glass door in this housing as shown in the accompanying photograph. A counterbalance is used to keep sufficient tension on the tape to keep it tight and to reel it on the spool as the tank fills or permit it to play out as the tank is lowered.

All of the sheaves operate on ball bearings and a trap, as shown in the photograph, is kept full of oil and prevents gas from reaching the steel tape. All of the bearings are equipped with alemite cups and lubricating oil is used to lubricate instead of grease. This is done because the oil has a tendency to flush the bearings and at the same time give a more satisfactory lubrication.

Hourly gauges are taken from the readings on the steel tape in the automatic gauges, and twice daily the gaugers gauge the tank from the hatch. All tank roofs are inspected periodically to detect any holes caused by corrosion. Whenever a hole is discovered a record is made of it, and it is plugged with a wood plug. Paint on the roofs usually peels more rapidly than on any other part of the tank, and these spots are usually painted over.

The water treating plant at Kemper is an important part of the station operation, and the average water consumption over a period of 12 months is around 450 gallons. Water is pumped into an overhead steel tank, and it gravitates into the 14,000-gallon treating plant. A solution is mixed in a mixer inside the boiler house, and pumped into the big treating tank where it is mixed with the raw water by an agitator.

On an average it requires four hours to treat a batch of water. After thoroughly mixing, the water is allowed two and three quarters hours for settling, and it requires the remainder of the time for the water to pass through the filter. Treated water gravitates into the reservoir.



Water-cooling tower at Kemper.

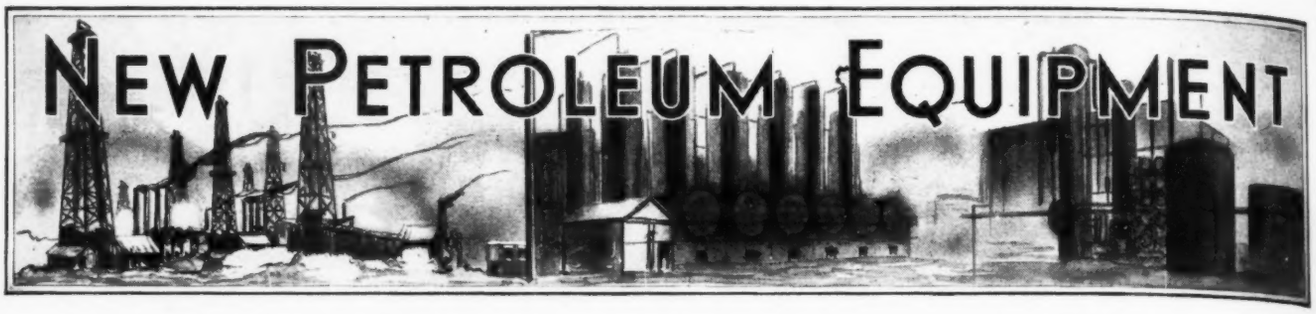
At Kemper station during the hot summer months the water requirements on some days almost equals the capacity of the water treating plant. To care for this an extra large reservoir was built, and to cool the water more rapidly and bring it to a lower temperature a cooling tower was built. All of the suction lines in the reservoir are swing lines.

Some companies use the continuous water circulating system, by sending the hot water stream through heat exchangers cooled by the incoming oil stream or by raw water. Where this system is not used, frequent samples of the water are taken for analysis to insure the proper solution being mixed at all times.

Kemper station is near a high voltage power transmission line, and gets the power for lighting and the operation of small motor-driven pumps from this source. The auxiliary unit is a 50-horse power engine, driving a 37.5 K. W. 440-volt A. C. generator.

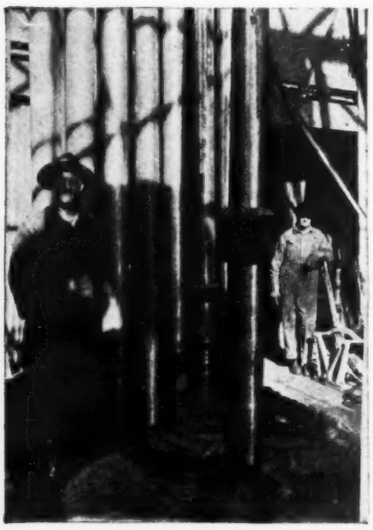
Sand storms make it far more difficult to keep all of the machinery free of dirt and sand. Kemper station's floor is brightly painted, and this aids to a great extent in keeping the station clean. A long and small hose with a long nozzle attached to the air compressor tank, is used to blow the sand out of all the cracks and crevices of the machinery as well as the corners of the station. To aid in keeping the sand out, as much of the machinery as possible is enclosed.

General view of the station.



Bettis Drill Stabilizers

A NEW development by the manufacturers of Bettis Protectors is creating widespread interest. It is known as the Bettis Drill Stabilizer, its purpose being to keep the drill centered and in vertical position, preventing side play and wobble and resulting in straighter drilling of the hole, according to the manufacturers.



The Bettis Drill Stabilizer is in reality an "enlarged edition" of the well-known Bettis Protector in that it is comparatively of the same shape, but comes in much larger sizes to run through casing from 9⅝" to 20" inside diameter.

These huge protectors, made entirely of rubber in the same manner as Bettis Protectors, are placed upon the drill stem immediately above the drill, spaced approximately 10 feet apart. Many operators continue the installation up to the bottom of the casing so that the drill pipe as well as drill stem retains its centered position in open hole.

The point of greatest distortion in the drill string, according to many drillers, is immediately above the drill and in open hole formation the pipe, when digging hard, tends to slightly corkscrew within the hole. By the use of Bettis Drill Stabilizers the pipe is forced to retain its vertical position regardless of the weight imposed upon the string.

There is ample play between the rubber and the wall of the formation so that circulation is not hindered in any way.

These huge rubber cushions are installed upon the drilling stem and drill pipe in exactly the same manner as Bettis Protectors. An expanding tool is used in conjunction with a cone so that the rubbers can be slid into their proper place. Their extreme tenacity, due to the inherent resiliency and the fact that they are stretched from a diameter smaller than the O. D. of the drill stem and pipe, prevents them from slipping. It is unnecessary to use the Stabilizers within the casing, according to Jack Ballagh, Secretary of Patterson-Ballagh Corp. He states that the regulation size Bettis Protectors are used in the casing and that the stabilizers are required only in open formation and upon the drill stem.

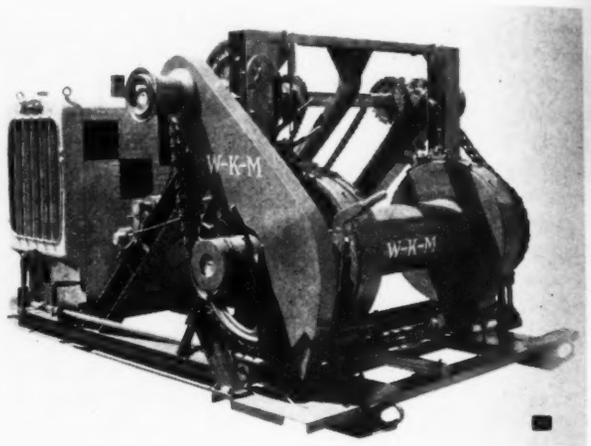
Approximately 100 wells are being equipped with stabilizers. It is believed that this new device will find ready favor in the Oklahoma and Mid-Continent fields and in many districts where a great deal of drilling is carried on in open formations.

Their manufacturers, Patterson-Ballagh Corp., have been preparing field data regarding the performance of the stabilizers and will soon be in a position to issue complete performance reports.

W-K-M 100 H. P. Master Winch

THE winch is patterned after a rotary draw works, entirely self-contained, and when mounted on a trailer is easily portable. It is designed to handle rod and tubing pulling, bailing, swabbing, plugging-back, re-setting casing, and any kind of cleaning-out work on the deepest wells drilled.

The winch comes equipped, as specified, with a 100 H. P. Waukesha or 100 H. P. Hercules motor, which provides



ample power for pulling work. Its structural strength is great enough for any load which can be pulled by the motor. Four speeds forward and one reverse afford a liberal range of line speeds and pulling capacities. All controls, including clutches, hand throttle, foot accelerator, reverse, and brakes, are centralized and easily accessible to the operator.

The Buda Company, Harvey, Ill., has produced a new type power unit with a special base, designed for oil field work. These units are unusually strong, steady and well balanced, and the manufacturers claim they can produce a steady flow of uniform power without vibration, and with new economies in operating costs.

The Shaffer Tool Works, Brea, Calif., is distributing a catalog concerning the Shaffer Cellar Control Gate, which is said to be a simple, easily-operated device for preventing blowouts, tubing wells under heavy gas pressure, and making water shutoff tests by pumping pressure inside of the casing. One feature of the gate is a minimum amount of vertical space is required in the cellar.

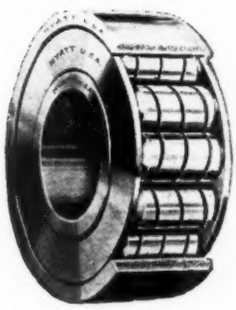
The Marley Co., Kansas City, Mo., has distributed bulletins describing spray deck cooling towers and fence equipment for spray pond work.

On the job with Hyatts—always!

Day after day "Caterpillar" tractors, trekking heavy loads over poor roads, find the going much easier on Hyatt Roller Bearings.

For smooth rolling Hyatts are practically frictionless. Grit and dust proof, they operate for years with no perceptible wear. Attention, too, is minimized to infrequent lubrications.

Equipment lasts longer when rugged Hyatts are employed. Immunity from bearing breakdowns insures smoother, faster, steadier operation.



In tractors . . . as in pumping powers, hoists, rotaries, draw works, reduction gear units and other field equipment . . . Hyatts provide lasting bearing satisfaction, and permanent operating economy.

Small wonder that equipment with Hyatt Roller Bearings is overwhelmingly preferred by oil well operators . . . favored because operators know that Hyatt protection means longer-lived, stronger built, money saving equipment.

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OIL WELL-5-30

When writing HYATT ROLLER BEARING CO. *please mention The Petroleum Engineer*

Norris Straight-Lift Jacks

FOR long-stroke pumping W. C. Norris, manufacturer of pumping equipment, at Tulsa, Okla., features a giant jack with a simple mechanical movement which insures a straight lift of polished rod up to 60-inch stroke.

These jacks permit the installation of powers for deep wells heretofore pumped only by the use of the walking beam.

Norris Giant Jacks are built of heavy structural steel sections and are recommended for pumping wells to 3500 feet depth. They are readily adjustable for desired strokes.

A catalogue of efficient surface equipment for the economical pumping of wells to 4500-foot depths, and which aids the producer in choosing the proper equipment for the efficient handling of fluid, will be sent on request.

W. C. Norris also manufactures a complete line of quality swedge nipples and bull plugs of all sizes and weights.

Sucker Rod Hook

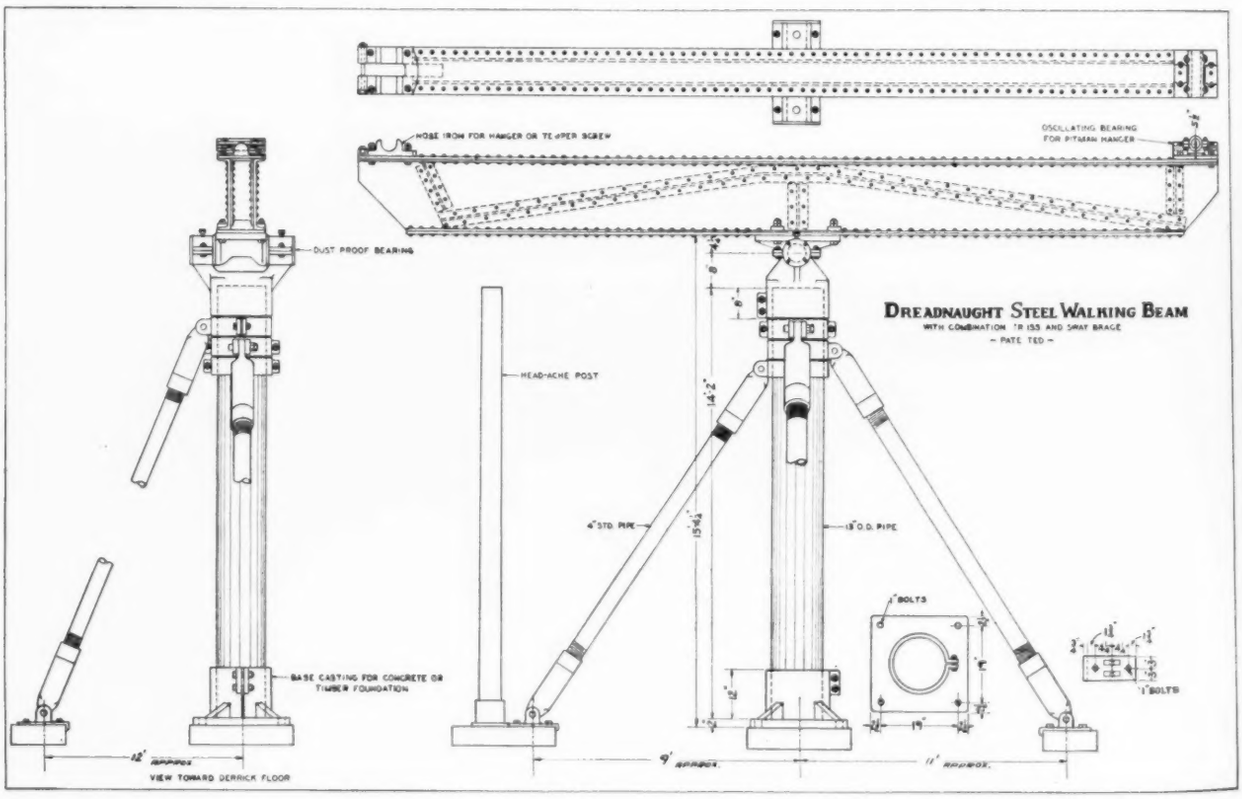
THE A. H. Neilson Mfg. Co. of Tulsa has recently introduced to the market the new improved Wedglock sucker rod hook shown in the accompanying picture. Some of the principal features of this hook are: The locking

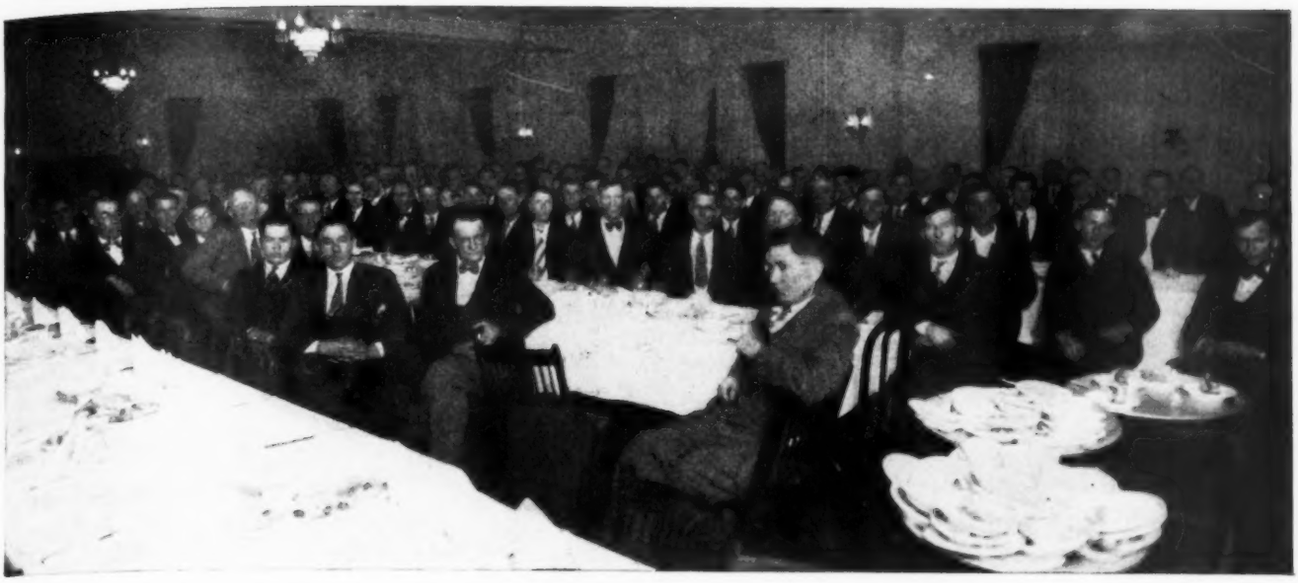
mechanism in the latch and handle which prevents unlocking of the latch except by pressure on the latch lever on rear of hook. It is also provided with an enclosed grease-packed bearing which prevents the bearing from gathering grit and grime, and always allows free swiveling.

New Walking Beam By Beaumont Iron Works

A NEW construction of walking beam for both drilling and pumping was designed by L. J. Black, and patents were recently allowed. The claims covered by the invention pertain to the method of internal bracing. It is claimed this brace performs the double function of acting as a truss to materially strengthen the beam, while supporting the down load, at the same time the brace prevents side sway of the ends of the beam while under load.

This beam was introduced in 1928, and is meeting a splendid reception from the operators in Texas and Louisiana, and is manufactured and sold by the Beaumont Iron Works Company of Beaumont, Texas.





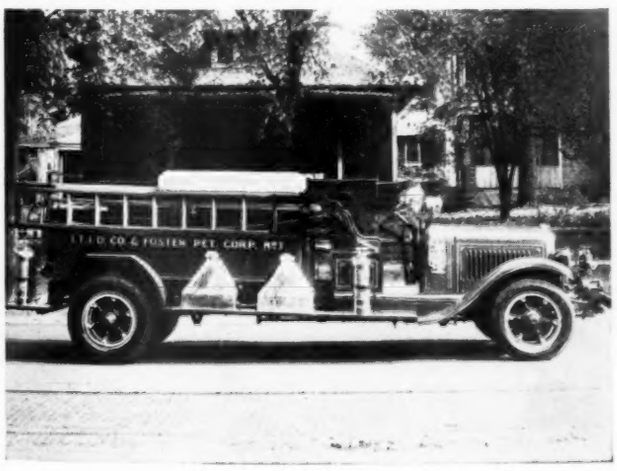
Lufkin Foundry & Machine Company Employes Hold Annual Banquet

LUFKIN FOUNDRY & MACHINE COMPANY, Lufkin, Texas, was recently host to its employes, numbering about 250, and a number of friends at its annual banquet in the ballroom of the Angelina Hotel. Entertainment was provided by local talent, assisted by a quartette from the office which was promptly "sent to the cellar" by a burlesque quartette composed of shop employes. W. C. Trout, vice-president and general manager of the company, acted as toastmaster, and commended the employes assembled upon their loyalty and efficiency with which they had worked during 1929, and announced a general wage increase to all employes in recognition of their services. A feature of the evening was the address by C. J. Rutland, safety engineer of the Texas Power & Light Company of Dallas. The year 1929 closed the most successful one in the history of this organization with sales well over double that of any previous year since its founding in 1900.

Cooper-Bessemer Calendars

THE feature which has distinguished Cooper-Bessemer calendars in years past has been the photographs of important engine and compressor plants. During the past year, Cooper-Bessemer equipment has been installed on some of the biggest oil and gas field projects ever attempted, and the new calendar was delayed until photographs of some of these recently completed installations were available.

Fire Engine for Oklahoma City Field



A new type fire engine furnished to the Indian Territory Illuminating Oil Co and Foster Petroleum Corp. jointly to combat fires in the Oklahoma City oil field.

It was designed by the American Fomon Corp., and sold by the Petroleum Chemical Co. of Tulsa, Okla.

Outstanding Construction Project

ONE of the outstanding oil storage construction projects of the last year was the fabrication and erection of four 80,000-barrel tanks of the Empire Pipe Line Company in the Oklahoma City oil field last fall, in forty days.

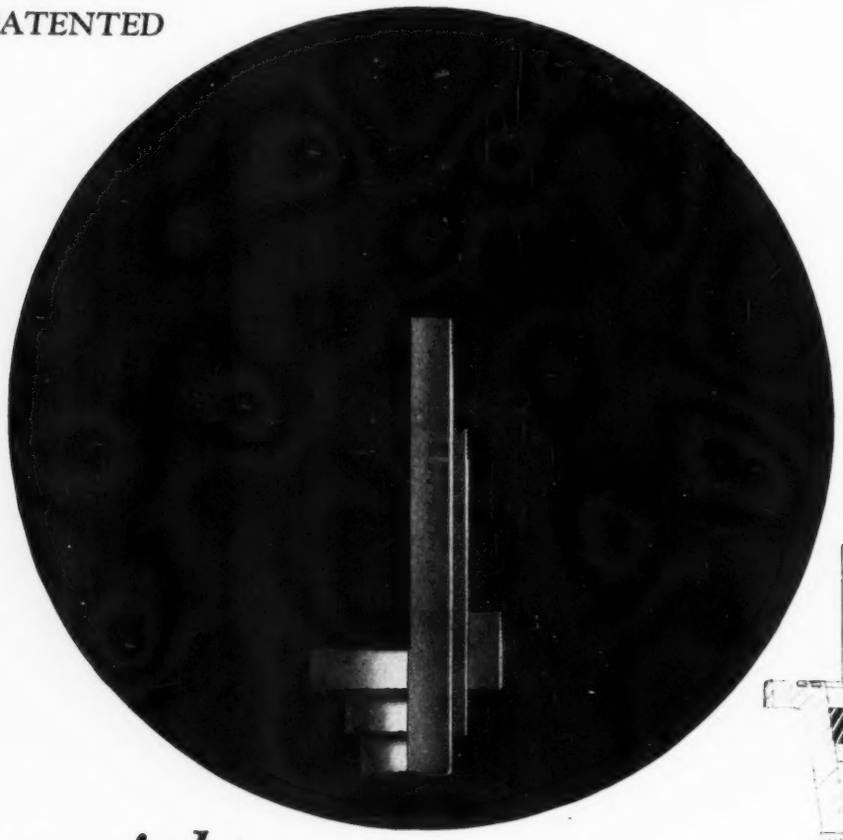
The Kansas City Structural Steel Company, which has built some of the larger storage tanks in use by the oil industry, was called upon to erect and fabricate storage facilities in the shortest time possible.

A $1,000-a-day bonus and penalty contract was entered into. The steel company was to have the first tank in service in forty-five days and the remaining three completed fifteen days later.

The company set to work at full speed.

Instead of one tank being ready for use within the contract period, all four were fabricated and erected in forty days.

FULLY PATENTED

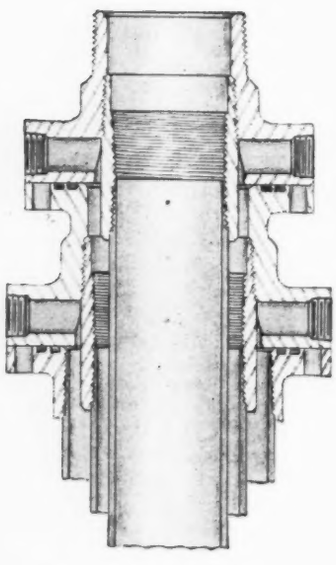


There's a *right* way and a *wrong* way of *CASING SUSPENSION*

for High Pressures

Deeper depths, heavier casing, heavier Christmas Tree fittings and greater pressures—call for the proper application of correct engineering principles in suspending casing and sealing the various strings. The use of Regan Control Flanges and Santa Fe Couplings removes strain from the casing. The weight is properly distributed. There are no compressing strains to cause the casing to warp or crimp. The weight is carried by the flanges which compress hydraulic packing that seals more tightly as more weight is imposed. Never more than one string is hung to a coupling. Each string of casing is suspended by its individual flange or spool. Regan Control Head equipment is made in various weights with test pressures up to 6,000 lbs.

Above view shows assembly of a Regan Control Head for pressures up to 6,000 lbs. and is equipped with a Landing Flange of a new design (optional with Bottom Flange) with notches to accommodate the tie rods. This Landing Flange rests upon a cement foundation.



THE RIGHT WAY

Detail view of a typical Regan hook-up showing the proper tying of casing. Note that no crimping stresses are imposed at any point.

Regan Control Head —the correct application

Regan

Forge & Engineering Co.

Oil Field Equipment

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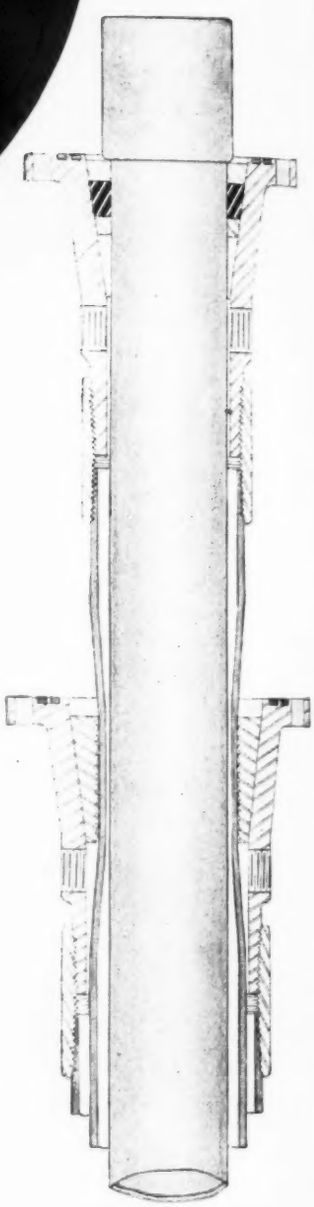


THE WRONG WAY

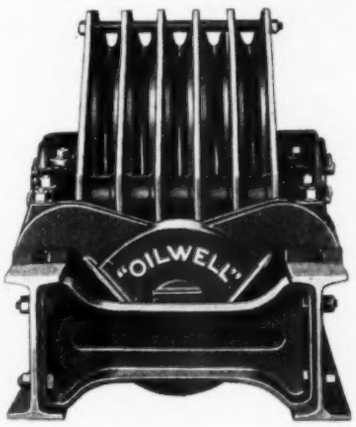
Detail view of a method of suspending casing, depending upon slips to hold the heavily weighted string. A set of slips will suspend one string of casing but when two long strings are suspended on one set of slips, crimping of the larger string invariably results.

When writing REGAN FORGE & ENGINEERING CO. *please mention The Petroleum Engineer*

A New Crown Block Accessory

THE Oil Well Supply Company is marketing a Cat Line Sheave Attachment for use with the "Oilwell" Center Pin Type Crown Block.

A cast steel carrier for the Cat Line Sheave saddles the I-Beams and is bolted to patented "Oilwell" T-slotted Slides. The attachment can be quickly mounted on or removed from the crown block. The sheave is 17½-inch O. D., bronze bushed and Alemite lubricated.



A large load capacity and convenient application are marked features of this new device.

The "Oilwell" 5-sheaves Center Type Crown Block is recommended for high speeds and heavy loads. Patented "Oilwell" T-slotted slides are welded to 15-inch, 65-lb. I-beams. The heads of the end bearing bolts fit in the T-shaped slots and cannot fall out to cause injury to workmen below. The slide feature also provides for easy adjustment of the Center Pin Assembly lengthwise on the beams. The heavily constructed end bearings are of the box and cap type, which design permits the Center Pin Assembly to be easily mounted on the beams at the top of the derrick.

High Manganese steel sheaves of 36-inch diameter and with rope grooves, ground to A. P. I. specifications, afford a good bending radius and a smooth surface to conserve the wire line. The sheaves rotate on heavy duty American roller bearings and each bearing is individually lubricated through grease passages from the ends of the center pin. The center pin has a carrying capacity greater than the combined safe working load capacity of the wire line.

Guard or housing can be furnished for the Center Pin Assembly. The "Oilwell" Center Pin Type Crown Block is available with 6 instead of 5 sheaves.

The "Oilwell" 5-Sheave Center Pin Type Crown Block is adaptable as the upper deck for "Oilwell" Double Deck Crown Blocks.

Folder No. 424, describing the Center Pin Type Crown Block and Cat Line Sheave Attachment, will be furnished on request at any "Oilwell" Branch Store.

Solving Power Factor Problems With Scale

THE General Electric Company announces a new system of solving power factor problems. This is a graphic method involving simple computations only, and is described fully in a new publication, GET-191, entitled "Solving Power Factor Problems by Scale."

Heretofore the calculations relating to power factor and its improvement have been difficult for those most vitally interested, and at best did not visualize the conditions that might result from different treatments. In brief, the new system consists of laying down to scale the known factors and then scaling the unknowns. Many problems are illustrated in the booklet, as well as several solutions for one problem, so that there should be no difficulty in applying the simple rules. Thus the effects and probable costs of improving power factor by unity-power-factor synchronous motors, by capacitors or by synchronous condensers may be scanned and compared. Increased load-carrying capacity is readily measured and rearrangements suggest themselves.

All that is needed for computation is a scale, a pencil and paper. A right-angle triangle with the sides in proportion 3 to 4 to 5 is furnished with the booklet and this, together with a small T-square, save time in the calculations and make the work more accurate.

In the actual calculations, horsepower at unity-power-factor is expressed in terms of inches measured horizontally. Lagging power factor is represented by lines slanting upward to the right, and leading power factor by lines slanting downward to the right. Where it is desired to improve lagging power factor and to determine the amount of leading power factor necessary to accomplish this result, a triangle is laid out using the horizontal unity power-factor line and the upward lagging power factor line. Then by applying the 3-4-5 triangle the necessary corrective value may be established. Other problems are solved in a similar manner.

Quasi-Arc Pipe Welding Demonstration

QUASI-ARC, INCORPORATED, with the assistance of their agents, the Welders' Supply Company, Tulsa, recently gave a complete practical demonstration of field pipe line welding with a Quasi-Arc four-welder equipment and using Quasi-Arc Asbestos Covered Electrodes. H. L. Amman, technical director of Quasi-Arc, Incorporated, personally directed the demonstration in conjunction with Mr. Harter of the Welders' Supply Company, and Mr. Boyle, Quasi-Arc engineer in Texas.

The demonstration was attended by a large number of prominent pipe line contractors and oil men who were extremely interested in the new and distinctive type of equipment, welding rods, and methods. Quasi-Arc, Incorporated, has conducted a thorough survey of field pipe line welding methods and equipment and has worked out the entire proposition in great detail.

Having a welding rod which they claim produces a perfect weld with great speed and with little or no dependence

upon individual skill, the Quasi-Arc Engineers based their entire procedure on it and, judging by reports of the demonstration, they have achieved excellent results.

One very interesting feature of the demonstration was the four-welder equipment, which weighed only about four thousand pounds. The Quasi-Arc Electrode requires such a low current that it is possible to keep the weight of the equipment down to this unusual figure and still obtain ample

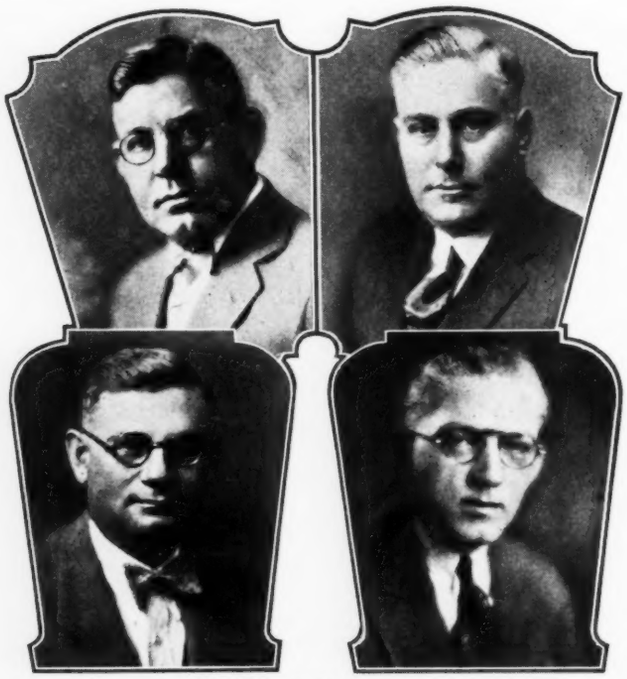
power. One of the facts emphasized at the demonstration was that Quasi-Arc Electrodes are entirely different from any other material on the market in make-up and action. They have been used throughout the world for the past seventeen years.

Axelson Company Changes Name

ACCORDING to an official announcement released by Jule C. Axelson, president, Axelson Machine Company, one of the largest manufacturers of oil field equipment and known in every field, will hereafter be known as the Axelson Manufacturing Company, Ltd.

The manufacturing policy of the company is being broadened in order to place the facilities of the company at the service of various industries.

During 1930 additional manufacturing units are to be added to the present large factory in Los Angeles so that new tools and new equipment of miscellaneous design can be manufactured without interference or interruption to the units devoted exclusively to the production of oil well pumps, sucker rods, fittings and other tools required in the oil industry.



Top—Jule C. Axelson (left) and Delbert F. Axelson. Bottom—Everett E. Kerfoot (left) and Clyde Elwood.

The officers include Jule C. Axelson, president; Delbert F. Axelson, vice-president and general manager; C. F. Axelson, executive vice-president; Clyde Ellwood, vice-president, director of sales, and Everett E. Kerfoot, secretary and treasurer.

During the past year the Axelson interests have erected new buildings and facilities at the Los Angeles plant location to a value in excess of $300,000. With a contemplated enlargement of the various manufacturing divisions it is stated that this building program will be continued during 1930.

At the present time the Axelson interests employ approximately 1,000 skilled workmen in the various branches, including field service men. The Los Angeles plant covers 12 acres and additional ground is owned by the company to provide adequate building extensions for the future.

The Axelson Aircraft Engine Co. is a separate company with its stock listed on the Los Angeles curb. During the past year a complete new plant has been erected to house the engine concern.

Plans for the development of an enlarged tool and gauge-making division are being consummated. For several years Axelson has manufactured gauges, tools and dies for a large number of manufacturers in the western part of the country, particularly for large oil companies. Axelson service in this respect will be extended to all manufacturers.

New equipment is being constantly added to the factories both in Los Angeles and St. Louis in contemplation of larger demand for Axelson products during 1930.

New Catalogue of Hamer Tools

The Hamer Oil Tool Corporation, Long Beach, California, has issued a catalogue describing the Hamer tools, which are the outcome of many years actual drilling experience of the president, L. S. Hamer, who is also the inventor of the tools. The catalogue is very complete.

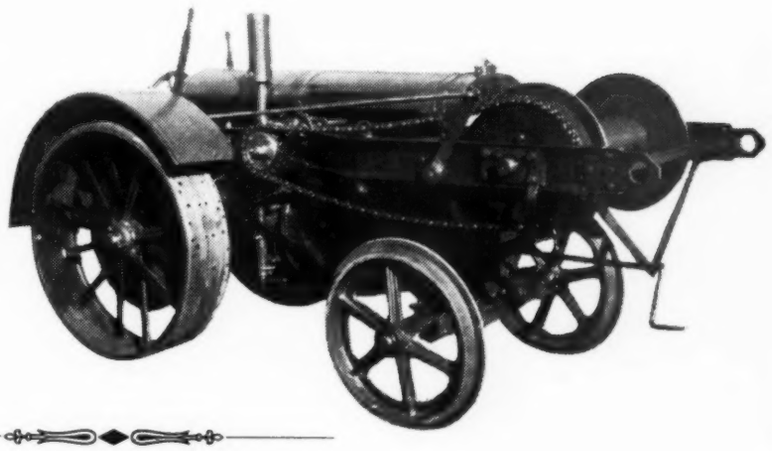
Model "B-2" W. K. W. Drilling Bit

W. K. W. was first to enter the field with a multiple tooth bit. The Model "B-2" was one of the early pioneers, and thousands have been used throughout the oil fields of the world with the utmost satisfaction.

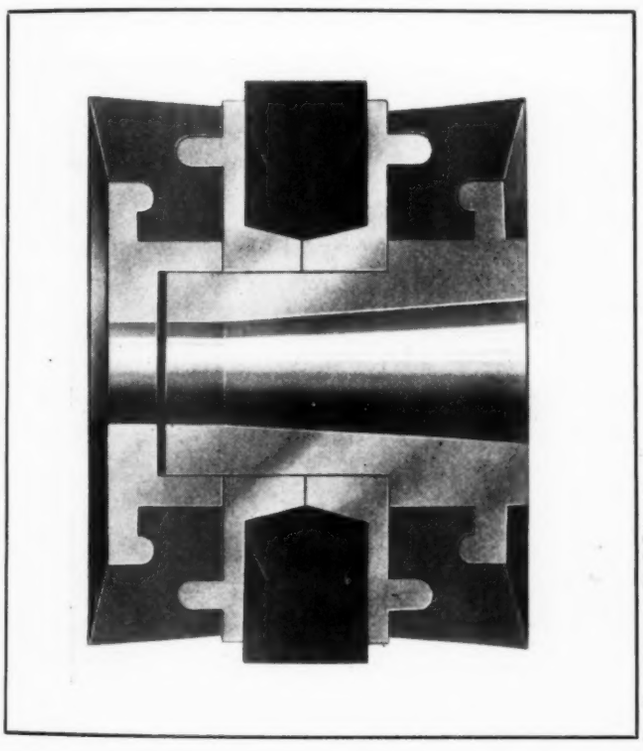
From time to time various changes have been made in the Model "B-2," such as arranging the teeth to perform to the best advantage in all kinds of formations. The principle, however, remains the same—that is, it cuts a core and then destroys it. The outermost blades contact the formation first, leaving a core that is broken down by the inner teeth as the bit is rotating. The core which extends upward within the bit acts as a guide and prevents the bit from deviating from the center line. This type of bit can penetrate the formation faster because only a small contact is made with the solid formation, and the core is much easier to destroy, owing to its partial isolation from the solid earth. Also, because of its design, this bit is made with much thinner teeth than is found on ordinary bits, without any sacrifice of strength. This feature makes it especially adapted to drilling with light weight. The extra reaming blades above the cutters keep the hole to gauge at all times.

A large number of surveys of holes drilled with the Model "B-2" bit show that they are less than three degrees off center. Many of these wells were below 6000 feet.

FRED E. COOPER, special oil field representative of the Advance Rumely Company, announces the introduction of the Rumley Doall Winch Tractor, pictured at right. This tractor is very compact, powerful, speedy, economical to operate and very easy to steer, according to the claims of the distributor. The winch is driven from both sides of the tractor from the main wheel drive shaft, eliminating all chance of side strain and pulling gears out of alignment.



A NEW type of slush pump piston involving new compression principles has just been introduced by Patterson-Ballagh Corporation, manufacturers of Bettis Protectors. Tests are being completed and the performance is said to be outstanding. The new Bettis Piston differs materially from the type originally marketed by the manufacturers. It consists of three rubbers, two follower plates and an end plate. The center rubber is called a displacement ring and its operation involves the principle of compression in conjunction with a displacement area.



The follower plates and end ring have projecting tongs which hold the end rubbers securely in place. The end rubbers are tapered outwardly toward the end, forming a tight seal when pressure is developed by operation of the piston, so that there are three annular wiping contacts at all times during operation.

The plates are drop forgings which give greater strength than by the former method of castings, according to the manufacturers. Literature giving full details regarding this new type of piston may be obtained by addressing Patterson-Ballagh Corporation, Insurance Exchange Bldg., Los Angeles.

AXELSON Sucker Rod Slips and Spider, illustrated below, are amply described in a folder distributed by the Axelson Manufacturing Co., Ltd., of Los Angeles.

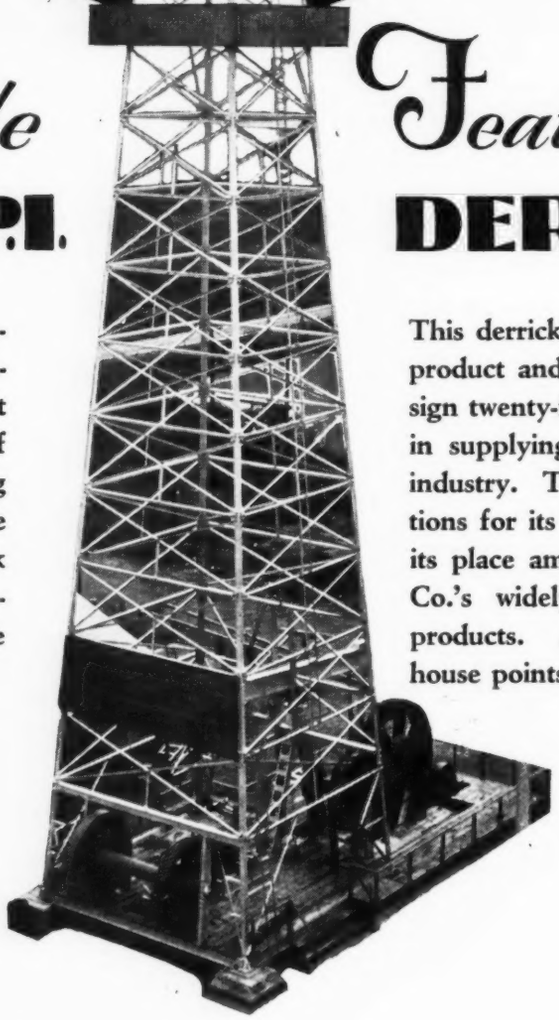
Increased length of sucker rod strength has made the factor of installation with maximum speed and safety one of prime importance. In present-day operations, loss of a string in a deep hole runs into far more money than any operator cares to consider. Axelson has developed, and is offering to the trade, sucker rod slips and spiders which

embrace speed and ease of operation. The use of one rod elevator is eliminated when running in or pulling out, and in addition to the actual saving of time, the possibilities of kinking rods is reduced to a minimum. In place the slips will hold any size or length rod string in use today.

INTERCHANGEABLE LEGS

...and other..

Desirable Features of the K.M. CO. A.P.I. DERRICK

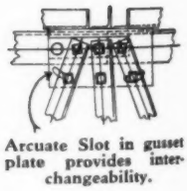


Legs are uniform and interchangeable, providing facility and economy in erecting derrick. Gusset plates used at all leg splices are of one-piece, special quality flanging steel and inner splice angles are milled to fit the fillet of the derrick leg. One size bolt for all connections. A. P. I. Specifications are the watchword of construction.

This derrick is a new Kirk-Morrow product and incorporates in its design twenty-five years of experience in supplying the needs of the oil industry. The painstaking preparations for its manufacture guarantee its place among the rest of K.-M. Co.'s widely used and endorsed products. Available at all warehouse points.

PRODUCTS

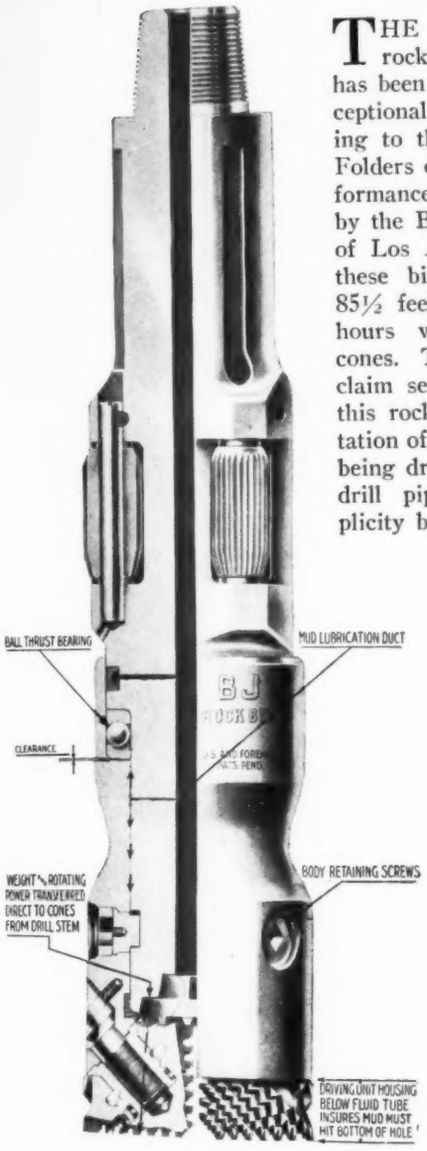
Steel Derricks, Rig Irons, Bull Wheels, Calf Wheels, Band Wheels, Crown Blocks, Tug Wheels, Sand Reels, Steel Tankage, Tank Fittings, Refinery Equipment, Steel Plate Construction.



Arcuate Slot in gusset plate provides interchangeability.

THE KIRK-MORROW IRON WORKS COMPANY

Sales Offices: Hunt Bldg., Tulsa, Oklahoma; Magnolia Bldg., Dallas, Texas; Central Bldg., Wichita, Kansas.


BALL THRUST BEARING
MUD LUBRICATION DUCT
CLEARANCE
BODY RETAINING SCREWS
WEIGHT ROTATING POWER TRANSFERRED DIRECT TO CONES FROM DRILL STEM
DRIVING UNIT HOUSING BELOW FLUID TUBE INSURES MUD MUST HIT BOTTOM OF HOLE

THE Byron Jackson rock bit pictured here has been meeting with exceptional success according to the manufacturers. Folders describing its performances are being issued by the Byron Jackson Co. of Los Angeles. One of these bits recently made 85½ feet of hole in 15½ hours with one set of cones. The manufacturers claim several features for this rock bit; positive rotation of cones due to their being driven directly from drill pipe, extreme simplicity by reason of fewer parts, and added safety as all main parts are drop-forged and heat-treated.

THE Foxboro Co., Foxboro Mass., presents a new Steam Flow Meter, based on the Famous Foxboro Orifice Meter. It is a mechanical meter, positive in action, and every motion of the recording mechanism is said to be mechanically positive, the smallest changes in flow being instantly recorded.

Appoint New Advertising Manager

McEVERLAST, INC., manufacturers and distributors of protective coatings for all types of engineering structures and of the "Hunt Process" method of curing concrete, announce the addition of O. A. Steller to their headquarters staff at 111 West Seventh Street, Los Angeles.

Mr. Steller, who has been appointed to the position of manager of the advertising department of McEverlast, Inc., comes to his new duties with a background of engineering, technical advertising and editorial experience.

Mr. Steller for several years was editor of the magazine "Concrete", an engineering publication with an international circulation. Previous to his connection with "Concrete", he was employed by the Portland Cement Association in the headquarters office at Chicago. He served this organization both in the Road Bureau and in the Advertising and Publications Bureau. During the more than 10 years with these two organizations, Mr. Steller has traveled extensively, visiting engineering projects and consulting with engineers in every section of the country. He has contributed engineering articles to a great many engineering magazines and has been active in engineering society attendance.

Shaffer Redesigns Testing Apparatus

MECHANICAL and petroleum engineers from all over Southern California have visited the Shaffer Tool Works plant recently to witness the remodeling of the hydraulic testing apparatus which has been redesigned to apply a possible cold-water pressure of 10,000 pounds per square inch.

Control gates, cellar fittings and Christmas trees for the "danger zones," where the pressures encountered present a constant threat to life and property, have to be thoroughly tested according to Shaffer standards, which require a cold-water test 1000 pounds higher than any possible field pressure.

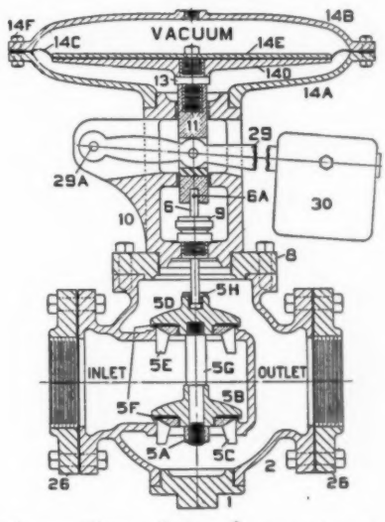
Actual rock pressures rarely register more than 3000 pounds, and a pump pressure of 3600 pounds (by compounding two 1800-pound pumps) is seldom exceeded, but no chances are taken, and strength of materials, yield points of bolts, flanges and gaskets are continually undergoing tests.

The enormous pressures, 5000 pounds per square inch and over, do not mean any danger at the shop, where cold water is used, it is pointed out by Shaffer engineers, but out in the fields, like Kettleman Hills, where high gravity oil and gas constitute a hazard to human lives and to expensive property, a blowout would be a serious matter to the entire field. Operators and engineers are demanding extreme precautions, and shop tests on entire cellar and Christmas-tree hook-ups are a part of the daily shop routine at the Shaffer Brea plant.

Fulton Vacuum Relief Valve

THE Fulton Vacuum Relief Valve, illustrated below, may be placed in the by-pass around a compressor, and will prevent the pulling of a vacuum on storage tanks at the section of the compressor. When pumping gas from a series of purifiers and a stoppage occurs in one of the tanks, the compressor would ordinarily pull a vacuum on the other tanks and probably collapse them. The Fulton Vacuum Relief Valve is placed in a line between the suction and discharge lines of the compressor, so that in case the pressure of the suction line drops to zero the valve will open and relieve the vacuum tendency. These valves are made by the Chaplin-Fulton Mfg. Co., Pittsburgh Pa.

Single Diaphragm Type



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Out on the producing lease where men must be men and where production in profitable volume is largely dependent on the type of equipment used—you will find Frick-Reid's QUALITY supplies doing their share in making your lease production results register on the profit side of the ledger. Check over the following list of equipment—note the responsible manufacturers and ask our representatives in your field to show you the items in which you are interested.

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BEAUMONT IRON WORKS CO.
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J. P. RATIGAN
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JOS. REID GAS ENGINE COMPANY
Two and Four Cycle Gas Engines, Pumping Powers, Refinery Equipment

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ROSSENDALE-RUBOIL COMPANY
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WALWORTH COMPANY
Fittings and Valves for all Branches of the Oil Industry

WHITLOCK CORDAGE COMPANY
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Centrifugal Method of Treating Diesel Engine Fuel Oil

JOHN M. McGREGOR

INEFFICIENT functioning of the Diesel engine due to rapid wear of such parts as rings and liners, fuel pump and valve troubles, and so on, can be traced to one of several causes or, frequently, a combination of some of these causes. It would be difficult to state which individual trouble is most frequently encountered, for each seems to have a distinct connection with the other. Worn liners and rings may be due to poor lubrication caused by the use of inferior oil or the method of application of the lubricant. It may even be found that lubrication is bad despite the fact that good oil is being correctly applied. When this occurs there must exist some indirect cause for the condition and, no matter what is found to be the real source of trouble, the results will be the same. However, when it is found that fuel oil is the reason for such conditions as noted above, the remedy is simple. The principal factors that give rise to poor economy in the working of a Diesel engine may be classed as follows:

(1) Poor lubricating oil.

(2) Incorrect quantities of oil, no matter how good it may be.

(3) Faulty lubricating systems.

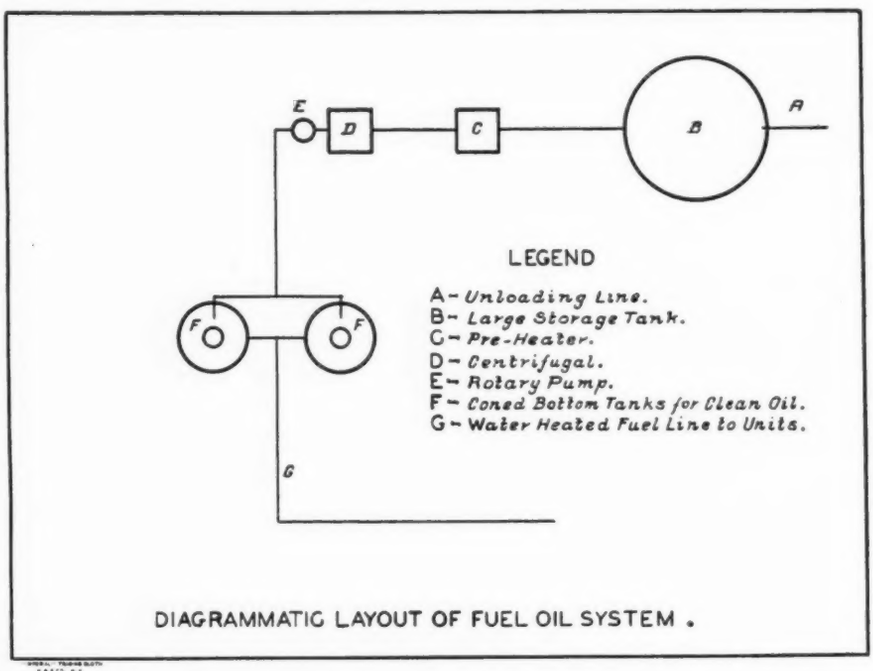
(4) Dirty fuel oil.

(5) Air containing a large quantity of abrasive material.

(6) An insufficient supply of cooling water or the use of water that causes scaling.

(7) Mechanical defects, such as mal-alignment or improper dimensioning or fitting of parts; badly designed or poorly fitted rings, etc.

With the single exception of poor design, which should not occur often in this day and age, every one of the faults shown can be remedied by the engine user. Unfortunately, many plant engineers are extremely lax in their attention to the things enumerated above, over which they have control, and it is no wonder that one frequently hears the statement that the Diesel engine is difficult to lubricate, that its rings and liners wear out rapidly, that pump plungers do not last any time or that spray valves are a continuous source of trouble. By using a little ingenuity and expending a little time and money, much can be done to remedy a condition that might give rise to an unfair comparison being made between the Diesel and the steam engine.



DIAGRAMMATIC LAYOUT OF FUEL OIL SYSTEM.

In articles which have appeared in previous issues of THE PETROLEUM ENGINEER the questions of liner and ring wear and the lubrication of Diesel cylinders have been discussed. It is now proposed to study briefly the fourth item on the list—*fuel oil cleaning.*

We cannot hope to get a perfectly clean fuel oil. Some are much better in this respect than others, but all contain a certain amount of foreign matter, much of which would act as an abrasive if it were permitted to enter the cylinders. Not alone would the liners and rings suffer, but probably greater damage would be done to such parts as fuel pump plungers, injection valves, etc., were an oil containing a considerable percentage of solid matter used without first cleaning it in some effective manner. No matter what fuel be purchased, care should always be taken to see that it does not enter the unit without first being cleaned, either by heating and settling or by the centrifuge method.

Where it is not possible to install a centrifugal machine (and there are few plants where such an auxiliary would not be a real economy), all fuel should be heated and allowed to settle as long as possible before it is used. This is best done by having two separate coned-bottom tanks both fitted with heating coils. One tank is used for the heating and settling process and the other as the working tank, the two being alternated. When the fuel is so treated, a fairly large percentage of the deleterious matter will go to the bottom of the heating tank. The pipes leading to the engines should be kept well up from the bottom so that the oil that is drained off will not be contaminated by the settlings. This method of treating fuel oil, however, is slow and extremely inefficient when compared to treatment by means of the centrifugal machine.

Apart from the solid matter, there is nearly always present a measurable quantity of water and, although a small amount evenly distributed throughout the fuel will probably be harmless, any considerable collection in one place may cause trouble. In addition to the wear that is sure to take place when dirty fuel is used, it must be borne in mind that the presence of foreign matter in the oil will lower the calorific value of the fuel and thus give rise to another source of lowered efficiency. Briefly summed up, the bene-

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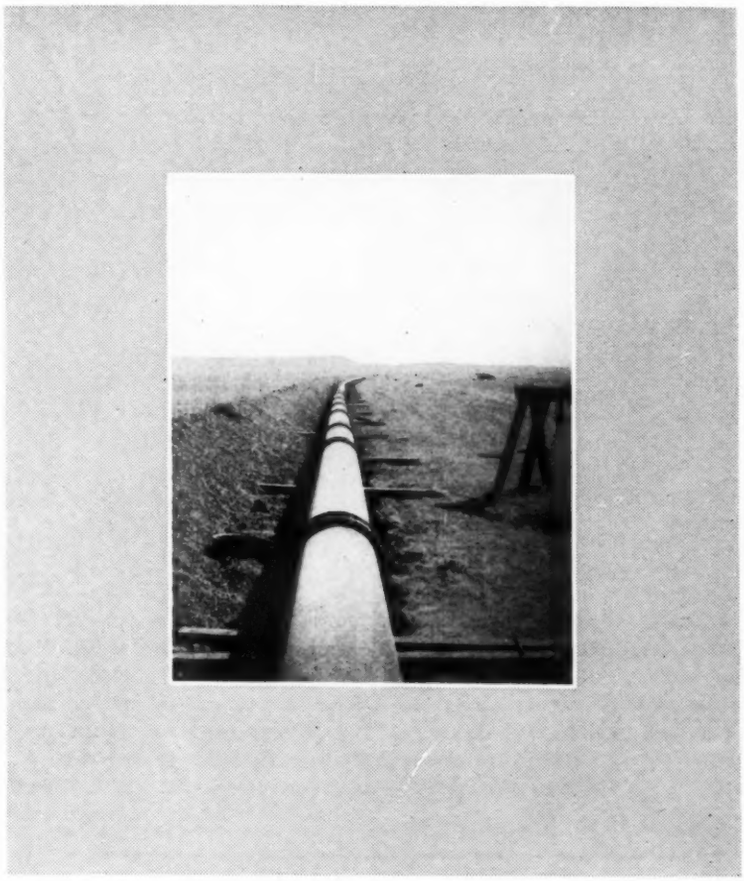

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fits accruing from the centrifugal treatment of fuel oil are:

(1) The oil is thoroughly cleaned of all solid matter and all water is removed.

(2) Ash content can be entirely removed.

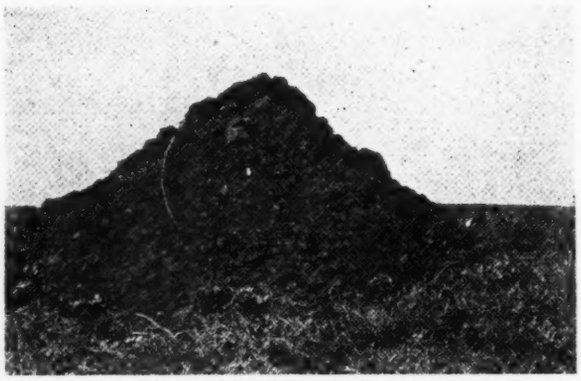
(3) The percentage of sulphur can be greatly decreased.

(4) The flash point is raised.

(5) The calorific value of the fuel is increased considerably.

As far as the troubles in the engine are concerned, we might dismiss the last two advantages, for if we can secure an almost perfectly clean fuel with a very low sulphur content many ills will be cured.

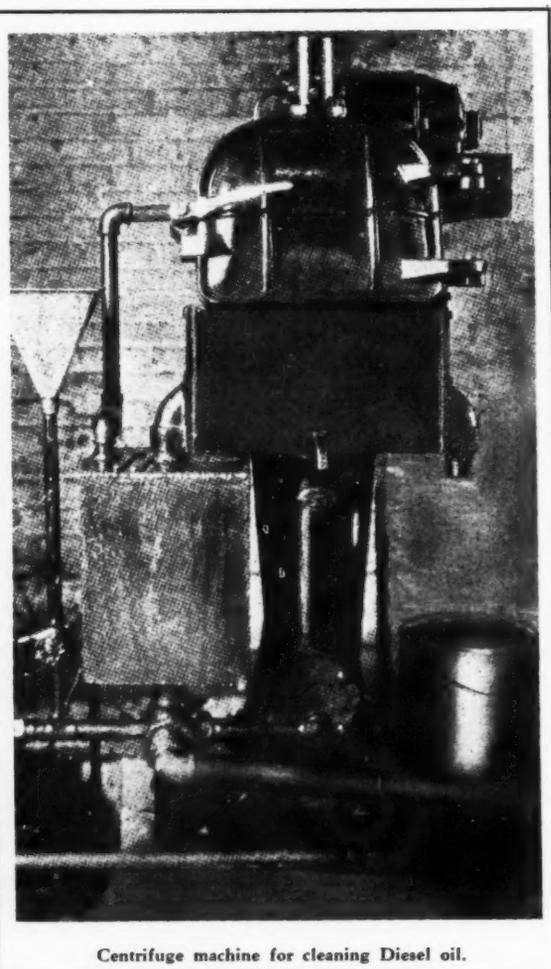
The presence of any considerable percentage of sulphur is often ignored. Where the units are run continuously under heavy load, the question might be dismissed; but when engines are started and stopped frequently, giving rise to the almost inevitable presence of moisture, the difficulty becomes a serious one. Fuel oil with a high sulphur content, unless it be thoroughly cleaned, should be avoided, as the sulphur burns to sulphur dioxide and sulphur trioxide, which, reacting with any water that may be present, will form sulphurous or sulphuric acids and cause pitting of the surfaces of the metal.



Pile of foreign matter removed at a pipe line station

The amount of foreign matter found in fuels will vary greatly, but figures taken from a considerable number of main line pumping stations give an average of one pound of solid matter removed from every five barrels of fuel oil treated centrifugally. To cite a typical case: On a main line station delivering 94,000 barrels of crude oil every twenty-four hours at a line pressure of 425 pounds it was found that a quarter of a pound was the average amount of dirt removed from the fuel necessary to pump 3,900 barrels of crude. This figure is seemingly small, but when it is considered that it means 180 pounds of dirt is removed during the course of a month or, over a year, the approximate total of 2,200 pounds is taken from the fuel, it will be readily seen that such an amount admitted to the units would most assuredly cause considerable damage.

A very interesting result was noted some time ago where three main line stations, exactly similar from the point of view of equipment and amount of oil pumped, were checked for liner wear and the general condition of the engine parts. All the units concerned were of the same make, type and horsepower, the same kind of fuel and lubricating oil were used and the average amount of lubricant consumed on each engine was approximately the same. The only difference in the three installations was that one station was supplied with a centrifugal machine for fuel oil treatment. The first thing noticed on dismantling and checking the units was the fact that the liner wear in the station using the centrifuge was less than half of that in the other two plants. Previous to the installation of the centrifugal machine the fuel was fed direct to the engines without heating or settling. At this time the spray valves would only last about twenty-four hours without cleaning and regrinding. When they were removed from the engine for this purpose they were found to be badly fouled and coated with an ash. Before installing the centrifuge, twin fuel tanks with steam coils were placed in service and an immediate improvement was noted. Fuel valves could now be run from 800-1000 hours without cleaning, but this figure was the limit. After the centrifugal machine was installed and placed in service a further improvement was seen; valves which had been in continuous service for 2,200 hours showed no signs of corrosion or fouling and no regrinding was deemed necessary before replacing them—a mere touch-up was all that was required to put them into perfect shape.

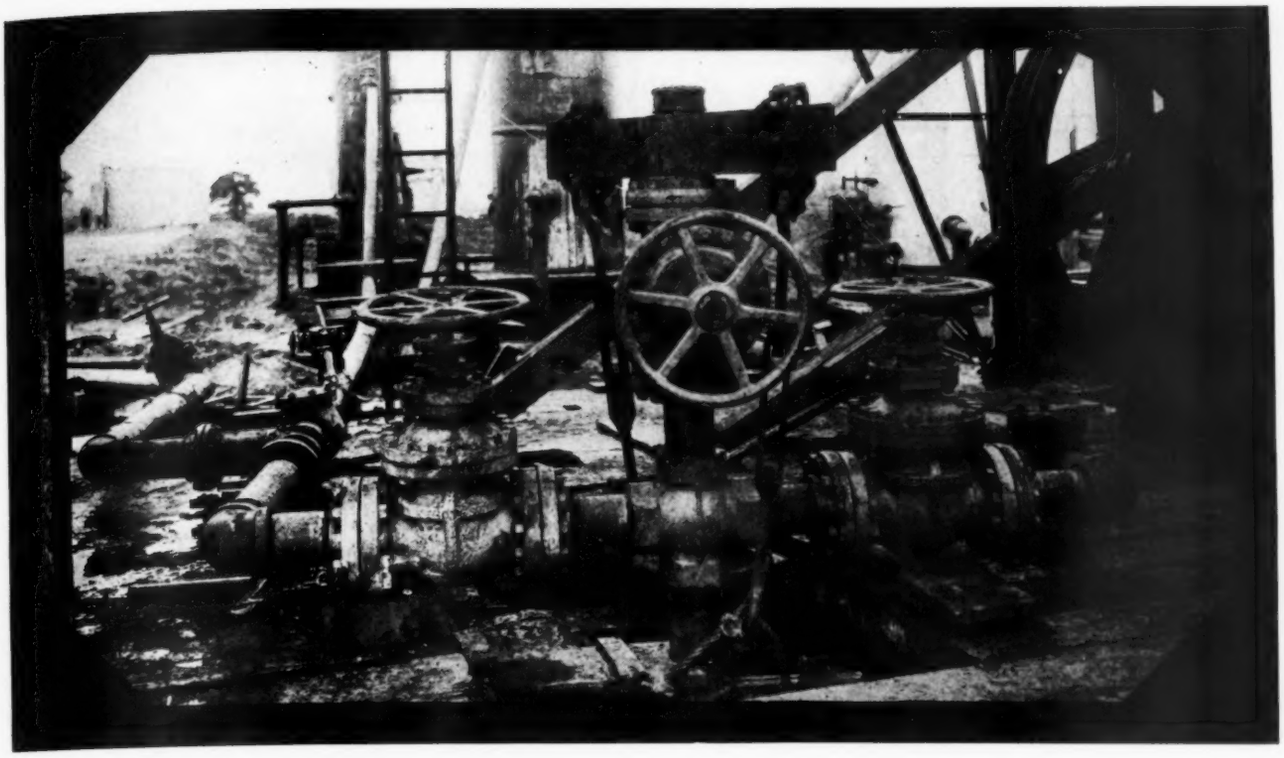


Centrifuge machine for cleaning Diesel oil.

Not only was the spray valve performance improved, but the condition of all other valves was correspondingly bettered. It is interesting to note, too, that fuel pump plungers were actually in better shape after the 2,200 hours' run than they were at the beginning of that time, for all leakage had stopped. Not only must the cost of replacements be considered, but there must also enter into the question the loss of production and labor charges. The case cited above, and similar experiences, proved conclusively to the company concerned that the centrifugal treatment of fuel oil was the only real means to be used, and these machines are now being standardized all over the system.

An extraordinary case arose recently and, although such an occurrence may be rare, had the company in question not been prepared to meet the emergency, a great deal of damage would almost assuredly have been done.

A shipment of 1,150 barrels of purchased fuel oil was received at a station, and from this amount a total of 9832 pounds of solid matter was removed. This amount equals



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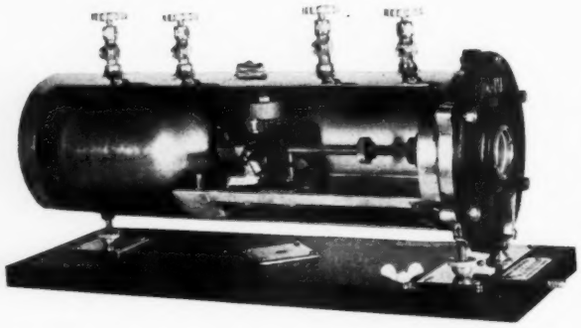

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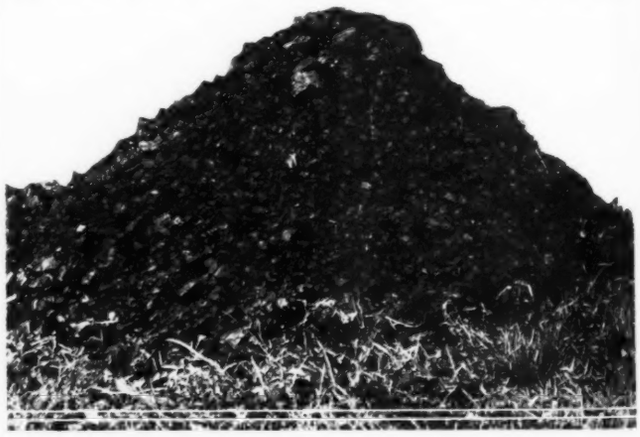
approximately 8.56 pounds taken from each barrel of fuel oil treated. The conditions were actually worse than shown by these figures, for during the first seven days the consignment of fuel was excellent and an average of only 2.5 pounds of solid matter was removed per day, this figure being far below the usual amount. Consequently, during the remaining twenty-three days the total of 9815 pounds of dirt was removed, giving an approximate average of 426 pounds every twenty-four hours. This is, of course, a very unusual case; nevertheless, it actually occurred and is liable to recur. Had it not been for the centrifuge it is almost certain that a considerable amount of damage would have been done before the condition of the fuel was noticed.

A description of a centrifugal machine would be futile. Suffice it to say that it gives us a quick, simple and effective means of cleaning oil by developing centrifugal pressure to a point thousands of times greater than the force of gravity.

The diagrammatic sketch shows a good lay-out for the handling of fuel oil. The oil is received in tank cars and is pumped into the large storage tank ("B"). From this tank it passes as required to a preheater ("C"), where the temperature is raised to between 140-160° F., thence through a filter which removes the larger parts of solid material and then gravitates to the centrifugal machine ("D"). A small rotary pump ("E") picks up the fuel after it has been cleaned and lifts it to one or other of the two coned-bottom working tanks ("F"), from which it flows to the units. The fuel line from the working tanks to the engines may be heated by fitting a smaller pipe inside it, the heat being supplied by hot water taken from the jackets surrounding the exhaust manifolds. Should the cleaning apparatus stop due to a break in the circuit supplying current to the driving motor, the supply of fuel can be immediately shut off automatically by the insertion of a solenoid valve in the line leading from the supply tank.



500 pounds of dirt which was centrifuged at a Kansas Pipe Line station.

The other photographs give a good idea of the quantity of dirt that is removed from the fuel oil cleaned in a centrifugal machine over a period of a few hours, and the centrifugal machine.

There is a centrifuge for the smallest as well as the largest stations. The amount of oil that can be handled varies from three to ten barrels per hour, according to the size of the machine installed, and of course the quantity will also be governed by the amount of dirt removed, more especially in extraordinary cases such as that cited above. However, even with the dirtiest of oils, the larger machines will be ample for the needs of any main line station. Whatever the cost of this auxiliary may be, the money expended will soon be returned by the saving in replacement of parts and the lowering of labor charges.

Mechanical Engineers Active in Petroleum Industry

THE American Society of Mechanical Engineers has arranged to have its national field secretary, Ernest Hartford, make his headquarters at Tulsa for a period of three to six weeks for the purpose of conferring with the executives and engineers of the petroleum industry as to ways and means whereby that society may actively engage in fostering the mechanical engineering phases of the industry. The Mid-Continent section of the A. S. M. E., which was formed in 1919, has its headquarters in Tulsa. At a meeting of its executive committee held in Tulsa upon the arrival of Mr. Hartford, it was decided immediately to launch activity by the following committees which have been appointed:

Production: D. L. Trax, chairman, consulting engineer, Gypsy Oil Co.; D. B. Dow, chief engineer, Indian Territory Illuminating Oil Co.; C. D. Watson, chief engineer, Carter Oil Co.; R. M. Carr, petroleum engineer, Sinclair Oil & Gas Co.; H. M. Manley, secretary, gasoline engineer, Barnsdall Oil Co.

Oil Transportation: F. A. Stivers, chairman, general superintendent, Texas Empire Pipe Lines Co.; A. N. Horne, general superintendent, Empire Pipe Line Co.; F. E. Waterfield, assistant chief engineer, Oklahoma Pipe Line Co.; B. P. Sibole, assistant to president, Sinclair Pipe Line Co.; J. N. Hunter, petroleum engineer, Gulf Pipe Line Co.

Gas Transportation: T. R. Weymouth, chairman, president Oklahoma Natural Gas Co.; Clay Briggs, chief engineer, Empire Companies; L. K. Laney, chief engineer, gas department, Texas Co.; W. D. Moorer, president, Moorlane Company.

These committees will undertake to appoint subcommittees to investigate various portions of their particular problems and incidentally set in motion the highly developed machinery and resources of the A. S. M. E. in matters of this kind.

Incidentally, new committees will be developed to undertake a study of the proper use of pressure vessels by the petroleum industry. The vast experience of A. S. M. E. gained in the development of its boiler code should be of material assistance in this new application of one of its component parts. A study and probable investigation through a series of experimental tests will be conducted on pipe line surge pressures to determine how best to diminish breakages in pipe line pumps and their connections.

Every member of the Mid-Continent section of the A. S. M. E. received recently a communication enlisting his aid and advice in formulating and then carrying out an intensive program for this study of the mechanical engineering problems in the various branches of the petroleum industry, including refining, oil transportation by pipe line, natural gas transportation by pipe line, natural gas production and petroleum production.

The first definite progress to be made under this aggressive policy of the Mid-Continent section, A. S. M. E., is the study of automatic pipe line pumping stations and their control. The paper work of this committee has extended over a period of two months and is now completed. The next step is the reconstruction of an experimental pumping station which was shown at the petroleum exposition last October. The data developed by the committee since that time requires a new series of experimental tests to prove that the theoretical developments of the committee are reliable and foolproof in practice.

Clamp Applied

The

SKINNER BAND CLAMP

for stopping pinhole leaks in welds. Equally effective on pinholes in center rings of couplings or in the pipe itself.

When applied the brass band shapes itself to the contour of the weld or center ring, while the pull of the bolt exerts heavy pressures over the full area of the band and stops the leak. Any suitable rubber will do for a gasket. Write for our new 29-O catalog.

M. B. SKINNER COMPANY

Sample St. at Falcon St. SOUTH BEND, IND.

SKINNER

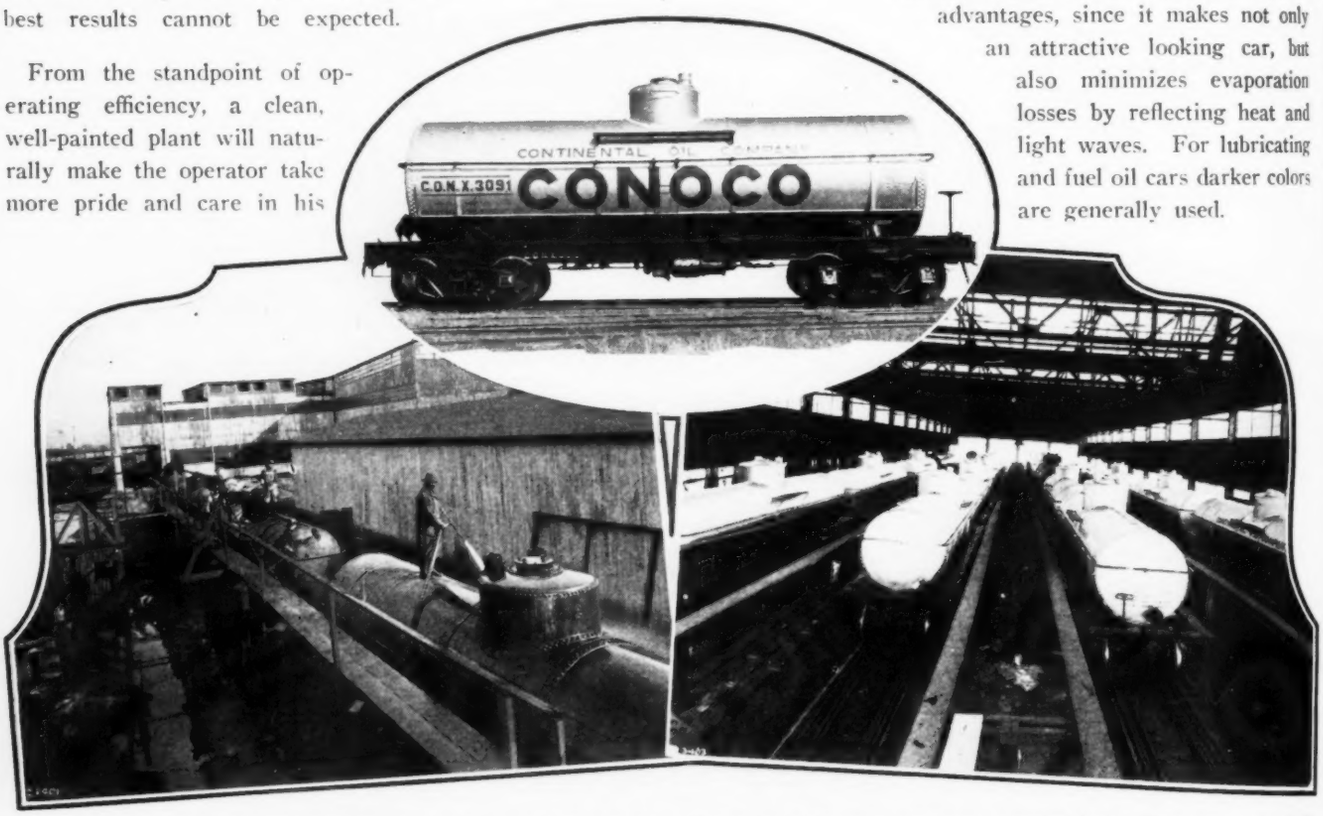
Practical Uses *of* Paint *in the* Petroleum Industry

UP-TO-DATE petroleum practice has illustrated the economic and operating advantages in the proper selection and use of paints. In addition to the chief advantage of protecting the surfaces of materials from corrosion and other harmful effects, it has special advantages in refinery and natural gasoline plant operations, and as a method of advertising in the attractive painting of tank cars.

In order to protect equipment subjected to corrosive action, various paint manufacturers have spent much time and money in research and practical tests to develop special kinds of paints to meet very severe conditions. By the proper selection and care in applying these special products, great savings in equipment have resulted in the refining industry. It is important that attention is given in selecting the proper kind of paint for a certain installation, and that the surface is either new or entirely clean before it is applied, and in some cases must be especially prepared for the kinds of paint used, otherwise the best results cannot be expected.

From the standpoint of operating efficiency, a clean, well-painted plant will naturally make the operator take more pride and care in his work. In order to minimize errors many refineries and gasoline plants use special color schemes to indicate the service for which the lines and pumping equipment are used. For example, steam lines might be painted blue, water lines gray, and gas lines red. This tells the operator at once what the line contains. It not only helps to break in new men in a shorter time, but it is often an aid to the older operator and of great advantage in an emergency. The practice of painting lines with a definite color scheme is frequently used in chemical and experimental laboratories with excellent results. Painting fire fighting apparatus and equipment has long been practiced by most refiners.

The advertising value of painting tank cars with an attractive color scheme is understood by many companies. The tank car is really a moving sign board, and is usually seen by very many people over a wide territory. The usual practice is to paint the gasoline car with a light color, or with aluminum paint. This has several advantages, since it makes not only an attractive looking car, but also minimizes evaporation losses by reflecting heat and light waves. For lubricating and fuel oil cars darker colors are generally used.



Top, a tank car used for transporting gasoline as it comes from the shop. Lower left, giving dirty tank cars a chemical bath. Right, where the tank cars are painted. Pictures courtesy Conoco Magazine.

BITURINE COATINGS

Biturine Enamel *Biturine Solution No. 5*
Biturine Enamel Primer *Biturine 70-30*
Biturine Coupling Mixture

This group of protective coatings represents the fruits of more than 20 years of careful research and practical experience. Biturine Enamel and Primer are particularly adapted to the Hill, Hubbell & Company process of mechanically applying protective coating to the pipe at the mill.

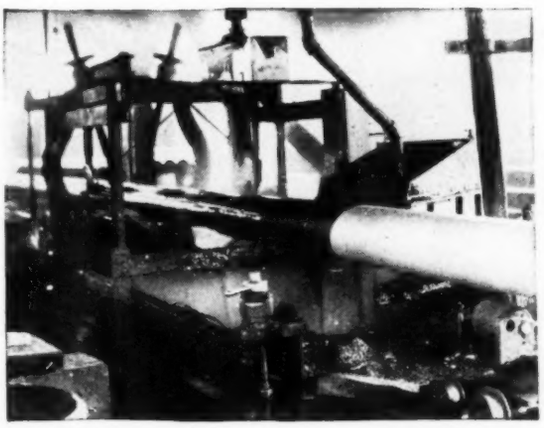
Mechanically coated and wrapped pipe. The newest development in pipe line protection

Now you can buy line pipe mechanically coated and wrapped *at the mill.* No longer need the laying of new lines or the renewal of old ones be subject to the hazards and delays caused by the old method of applying the protective coating in the field. Your pipe is delivered to you ready to lay, fully protected by the Hill, Hubbell & Company process of coating the pipe and wrapping it at the mill.

It is generally accepted by authorities that *proper application* of pipe line coating is the most important feature in the success of any form of protection. Field applications under the most ideal conditions have never been productive of a 100% satisfactory job in all cases, owing to the unfavorable conditions under which the work had to be carried on—inclement weather—unskilled labor—varying temperatures—the difficulty of properly cleaning the pipe and applying the coating of the protective material so as to cover the surface thoroughly.

The Hill, Hubbell & Company process of mechanical application at the mill eliminates all these difficulties, and presents the following outstanding advantages:

1. The pipe is thoroughly cleaned of all rust and mill scale.
2. It is not only thoroughly dry but warm when the primer is applied.
3. The required thickness of the protective coating of Bitumen is applied *before* the felt is applied.



The Coating and Wrapping of the Pipe is a Continuous Mechanical Process

4. This thick coating is applied in two coats, insuring freedom from pin holes and bubbles.
5. The coating of felt is applied under tension and is exactly spaced and, therefore, perfect.
6. The whole process is mechanical, involving no human element, and no waste.
7. The entire operation goes on under roof and can proceed night and day regardless of weather.
8. Exact temperature control of the Bitumen is possible. This is important and cannot be had in field operations.

Plants for the mechanical coating and wrapping of pipe are located in the following cities for the production of the pipe manufacturers listed.

Central Tube Company, Ambridge, Pennsylvania; Spang-Chalfant & Company, Ambridge, Pennsylvania; Youngstown Sheet & Tube Company, Indiana Harbor, Indiana; National Tube Company, Lorain, Ohio; A. O. Smith Corporation, Milwaukee, Wisconsin; Youngstown Sheet & Tube Company, Youngstown, Ohio.

Others are contemplated and will be installed in the near future. Each of these plants is equipped to handle pipe up to 24 inch diameter and to conform to specifications covering a wide range of combinations of materials.

Write to our nearest office for literature descriptive of the process and for details regarding specifications.

GENERAL PAINT CORPORATION
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CHICAGO NEW YORK TULSA HOUSTON DALLAS SAN FRANCISCO
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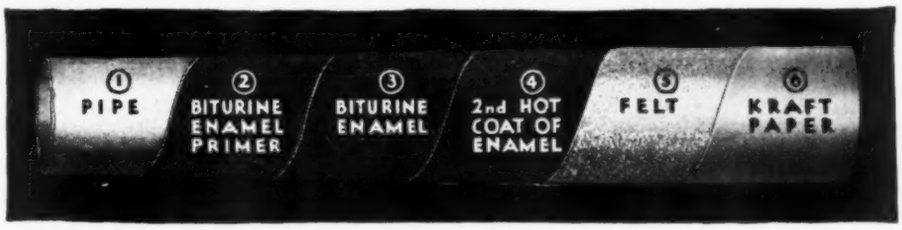

Hill, Hubbell & Company Machine Coated and Wrapped Pipe is Your Best Insurance Against Corrosion

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MANY oil companies the world over are standardizing 100% on McEVOY wireless well screens, McEVOY heads, and other McEVOY products, because their efficiency contributes to successful operation and profits. Field Superintendents, Drillers, and Oil Company Executives of long experience in international oil production have found out the value and economy gained from the sound engineering and design embodied in McEVOY OIL FIELD EQUIPMENT.

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McEVOY OIL SAVER screws into McEvoy head. For sucker rods, tubing and casing.

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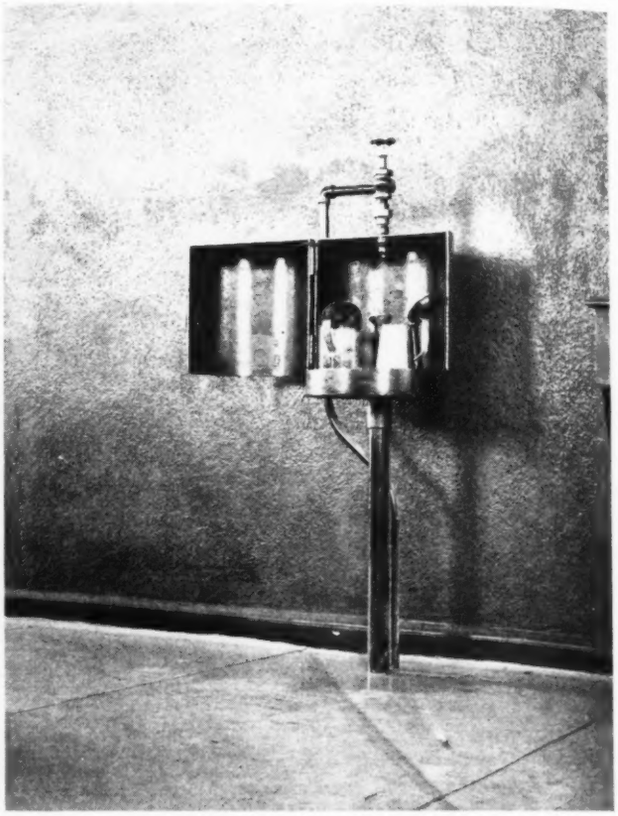
Houston, Texas . . . U. S. A.

Shop Made Oil Receptacle Keeps Station Floors Clean

On the pump room side of the Prairie Pipe Line Co.'s Panova, Oklahoma, station is a shop made oil receptacle that was inexpensive to construct and makes it easier to not only keep the floors clean but to draw oil for the lubricating oil cups.

The shell of the receptacle is made from a piece of 16-inch pipe usually cut from an old joint found in the warehouse yard. A plate made from sheet metal and with a short



nipple in the center is welded on the bottom completely around the pipe. About three inches from the bottom and half way around the receptacle a torch is used to cut a door which after being cut is hinged to the remainder of the receptacle. Two semi-circular pieces of sheet metal are welded to the top and a spigot pipe is inserted in the top part of the circle. In the bottom of the receptacle ribs slanting towards the center have been put in to keep the oil pots off the bottom and to permit any oil on the pots to drain off.

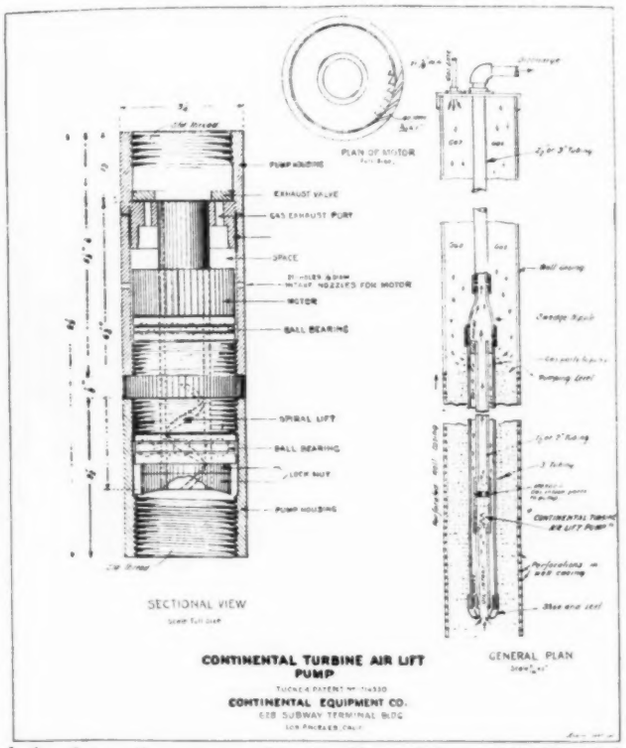
The flow line comes from the overhead tank in the station and from this the oilers obtain their oil by opening the valve on top of the receptacle. A drain pipe leading to the sump is screwed into the nipple on the bottom of the receptacle and supports the entire device. If any of the oil flows over the pots it drains into the sump and is later picked up by the sump pump and put back in the overhead tank after being run through a reclaimer. The door of the receptacle opens the device in half as shown in the accompanying photograph and makes it easier to draw oil. The device is made more attractive by an application of paint and it has been found in this station that it goes a long way toward aiding the oilers in keeping the painted floors free of oil spots.

New Principle Developed in Pumping

SINCE the inception of the petroleum industry seventy years ago, only two genuinely basic principles of lifting the crude have been brought forth; namely, the reciprocating plunger pump with rods to transmit the power from the surface to the fluid level and, secondly, the air lift or jetting method of applying pressure to the oil. There have, of course, been many supplementary developments and excellent improvements, but in the final analysis these two methods have been the predominating principles in raising oil.

An important change in production methods, and what might be called a third principle of oil recovery, is what is called the "atomizing method," whereby the oil is elevated from its fluid level through tubing by a combination of mechanical atomization and hydrostatic load relief.

This principle of raising the oil is the invention of Ralph H. Tucker, who has devoted thirty-two years to the pumping of oil in all of its various classifications. He was one



of the first oil pumpers in the Kern River (California) field thirty-two years ago and has been constantly identified with the pumping phase of the petroleum industry since that time.

Mr. Tucker decided that some apparatus could be designed to pull in the fluid and mechanically atomize it so that the load would be reduced.

The final result has been the design of what is called the Continental Turbine Air Lift Pump. Some engineers consider the word "pump" as a misnomer in that the mechanism does more than merely pump the oil by reason of the atomizing effect.

At the bottom of the tubing a swaged nipple is used to convert the tubing to a larger size to permit insertion of 1½" or 2" tubing, which in turn allows for packing. The assembly below the swaged nipple is lowered to the pumping level so that the gas ports are immediately above the level, allowing the gas to enter the packed off area and in turn enter the pump. The oil intake is at the bottom, similar to any other pumping method.

The Continental Equipment Co., Subway Terminal Bldg., Los Angeles, is manufacturing the pump.

THE World's Largest Pumping Well

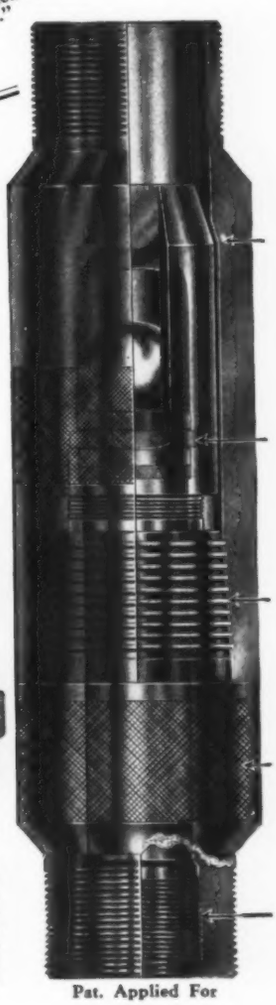
Excerpt from
The OIL WEEKLY
Issue of December 27, 1929, Page 32

"The biggest pumping well in the world, so it is claimed, is located in the Lea area, New Mexico, nine miles south and 25 miles west from Hobbs. It is owned by Cranfill & Reynolds of Dallas, and is known as Statelands 1-B, located in Section 2-21-33, at a point 3300 feet from the north line and 660 feet from the east line of the section. Although this well encountered only five feet of pay at 3750 to 3755 feet and has no gas pressure to make it flow, it is pumping 2100 barrels of 31° oil per day. It is being operated by standard rig, with four-inch tubing, and three and three-quarters inch working barrel, at a speed of 17 to 20, 72 inch strokes per minute."

THIS remarkable well is equipped with a 4-inch Petro Oversize Standing Valve and Nu-Alloy Balls and Seats—this service record is in keeping with the reputation Petroleum Equipment Company products have so justly earned for pumping equipment that delivers constant and uniform performance. Our field representatives who are pumping equipment specialists are at your service.

Immediate Shipment

Within two hours after your order is received, your supply store can secure immediate shipment of Nu-Alloy Balls and Seats. Branches: Tulsa, El Dorado, Houston, Coffeyville. Headquarters and Plant: Ft. Worth, Texas.



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PETROLEUM EQUIPMENT CO.
Fort Worth, Texas

JOHN R. LONG, *Manager* - Plant and Office: Ft. Worth, Tex.

When writing PETROLEUM EQUIPMENT CO. *please mention The Petroleum Engineer*

A Continuous Pressure Distillate Treater

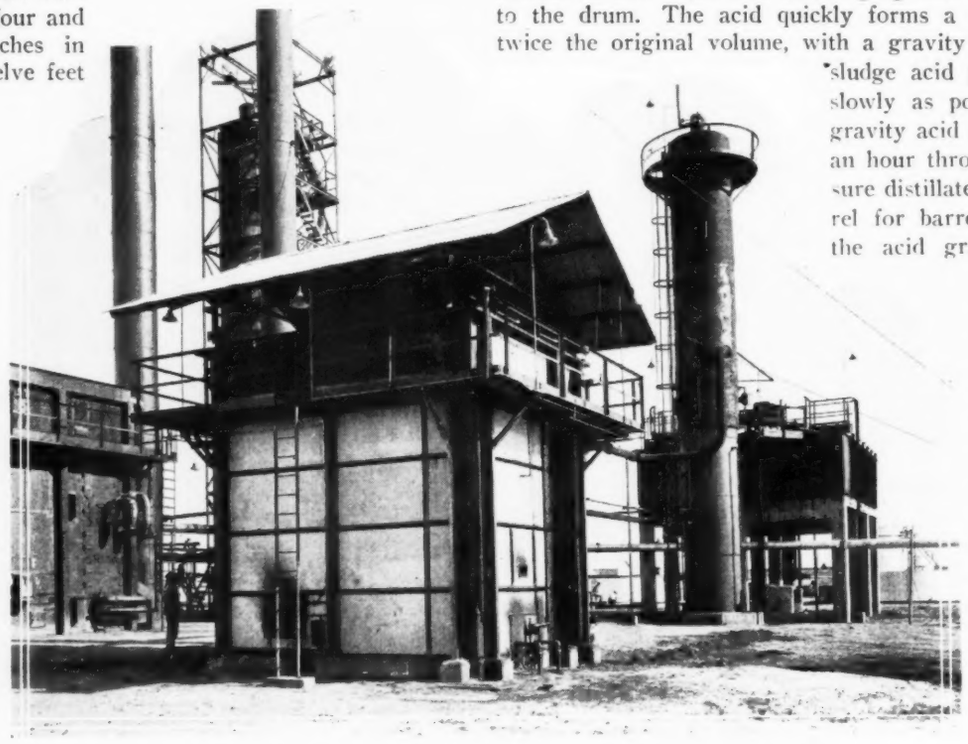
L. C. ATCHISON,

Chief Chemist, Crystal Oil Refining Corporation

A CONTINUOUS treater had been tried before, but with scant success. We had gone back to the use of batch agitators, with the attendant increase in cost, and poorer results. It had become imperative that we have additional equipment, so the first treater was completely redesigned.

The basic part of this design had been worked out some time before by the refinery superintendent. Four drums or settlers are used, each one eight by eighteen feet. These are placed upright, the bottoms about five feet above ground level. Each drum can be drained to the sewer and is also provided with an outlet for the chemical being used.

In each drum is placed a cone, small end uppermost; this small end being tied by a four-inch line to the outside. The lower end of the cone is four feet above the bottom of the drum, and is suitably supported by angleiron, but is open to the drum proper. This gives a cone of four and twenty-one inches in diameter and twelve feet in length. The cone and settler serve as two settlers without the consequent turbulence of the material when transferred from one to the other. The reagent drops straight down with constantly decreasing velocity, while the pressure distillate having done likewise gets a second chance to follow a path where its velocity constantly decreases.



Rerun still in a West Texas refinery

Between each drum, the line carrying the liquid drops from the top of the drum to ground level, over to the next drum, then up to the top of the drum into it and into the cone. On the upflow side of the line between settlers, Duriron mixers are placed. These mixers are spaced four feet apart, the reagent being introduced where the pipe turns upward. All reagent lines are two-inch and run to suitable manifolds, these in turn being connected to the regular and standby pumps. This manifolding allows for flexibility of treatment by the turning of a few stopcocks. Stopcocks are used throughout on both chemical and gasoline lines.

The pressure distillate to be treated is from two sources, the major portion coming from the cracking units. This is caustic washed before reaching the rundown tanks and has the following properties at that point: Sulphur, .30%; gum 50 to 60 mgs.; Doctor test positive, and corrosion bad. The second distillate is from a pipe still. It has a high end-point, 5% of sulphur, and about 100 mgs. of gum, and a few other detracting qualities. The ratios of the two as treated vary from all of one to all of the other.

It was originally intended to use sludge acid on the first drum; this to be obtained from fresh acid used on the second drum. Calculations were based on a six-pound per barrel treatment. The third and fourth settlers were for water and caustic.

This obviously over-treated the material, so that the following treatment was worked out. Thirty barrels of fresh 66 Be. acid is pumped to the first drum, where it is circulated by the sludge acid pump, taking suction from the bottom of this drum and discharging into the mixers back to the drum. The acid quickly forms a sludge of about twice the original volume, with a gravity of 45 Be. The sludge acid pump is run as slowly as possible with this gravity acid and a 100-barrel an hour through-put of pressure distillate. This is a barrel for barrel treatment. As the acid gravity drops the sludge acid pump is speeded up to correspond. At 30 Be. one-half the sludge is pumped to the pit and fifteen barrels of fresh acid added. This brings the gravity up to 48 Be. One pound of acid in this treater is doing the work of six pounds in the batch agitators. This treatment left the second drum as an additional settler for the acid.

Sixteen Be. caustic is used in the third drum. Sixteen Be. caustic is satisfactory in every way, and is least apt to form an emulsion. Almost every strength of caustic was tried, but at first they all emulsified. Caustic, after acid without an intervening water wash, can be expected to cause some trouble, but nothing of the sort had occurred with batch agitators. The intervening water wash is customary; however, we have consistently obtained better results both on straight run and cracked products by using caustic immediately after acid treatment. This emulsion was not caused by acid left in the pressure distillate; in fact, the amount of acid was less than that held in similar material on a batch agitator. Two accidental discoveries helped us

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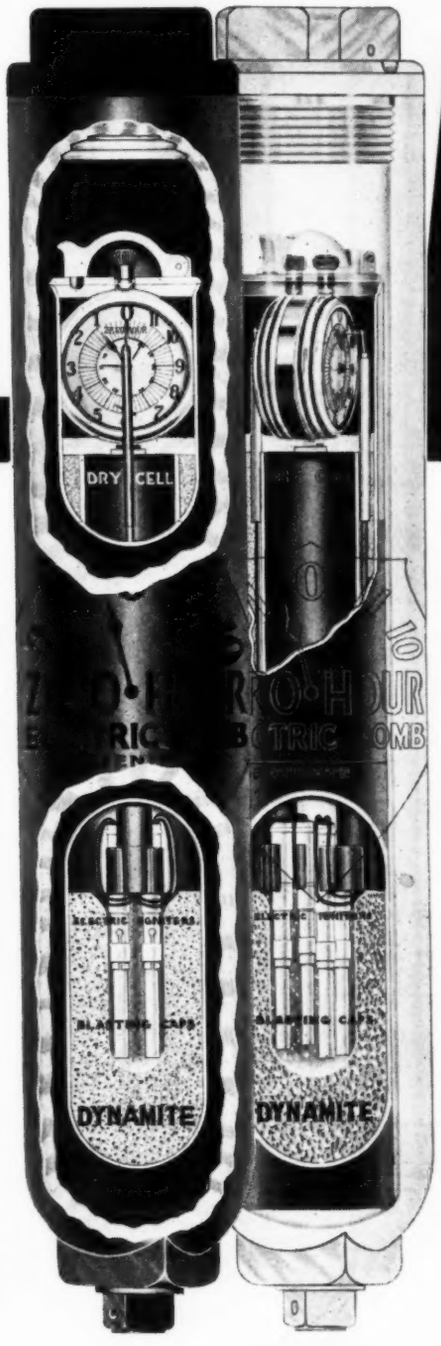

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FOR THE DUPLEX Zero Hour Electric Bomb

Plug and Socket Connectors ..... Improved Firing Pin

What has been your hardest shooting problem?

Many experienced operators have come to consider Zero Hour Electric Bombs as almost indispensable for putting off sand-tamped shots; shots where a liner is pulled, after the charge is placed; shots where the pipe is pulled, almost invariably burying the charge; shots where fluid is swabbed down, pulling in cavings over the charge; putting off the shot in a deep, crooked hole; in trouble shots to sidetrack tools and in shots to salvage casing in deep holes containing heavy fluid. These operators recognize in the Zero Hour Duplex Electric Bomb a degree of perfection which makes it the *super-utility means* for putting off any and every kind of shot. In every way that a time-controlled, electrically operated detonating device excels an obsolete method, the Zero Hour Duplex Electric Bomb carries that excellence to the super degree.

The Duplex is not a "double" bomb. It is enclosed in the same size container that formerly held the original Zero Hour Bomb. But all of its vital working parts have been duplicated, hence the Duplex principle. There are two watches and two sets of blasting caps where one was contained before. In this manner there are two complete timing and firing mechanisms, each independent of the other, enclosed in the same metal, fluid-tight container that formerly held one only. By this addition the chance of a failure with the Duplex Bomb has been reduced to a figure so small that it is almost beyond computation in ordinary mathematics. The only additional operations in setting are the winding and setting of a second watch, identical with the first one, followed by the attachment of the additional igniter and blasting caps. This attachment has been simplified by a plug and socket connection, assuring perfect electrical connections by merely pushing in a plug. The gold spring firing pin holds accurately to the "O" firing point, no matter how often the hour hand passes either forward or backward across it, in testing. Because the Zero Hour Duplex Electric Bomb puts off *any* shot so positively, safely and economically, it is the perfect and preferred means for *all* of them.

Zero Hour Electric Bomb

ZERO HOUR TORPEDO COMPANY, 408 COSDEN BLDG. TULSA, OKLAHOMA

Zero Hour Bombs are obtainable through all principal torpedo companies

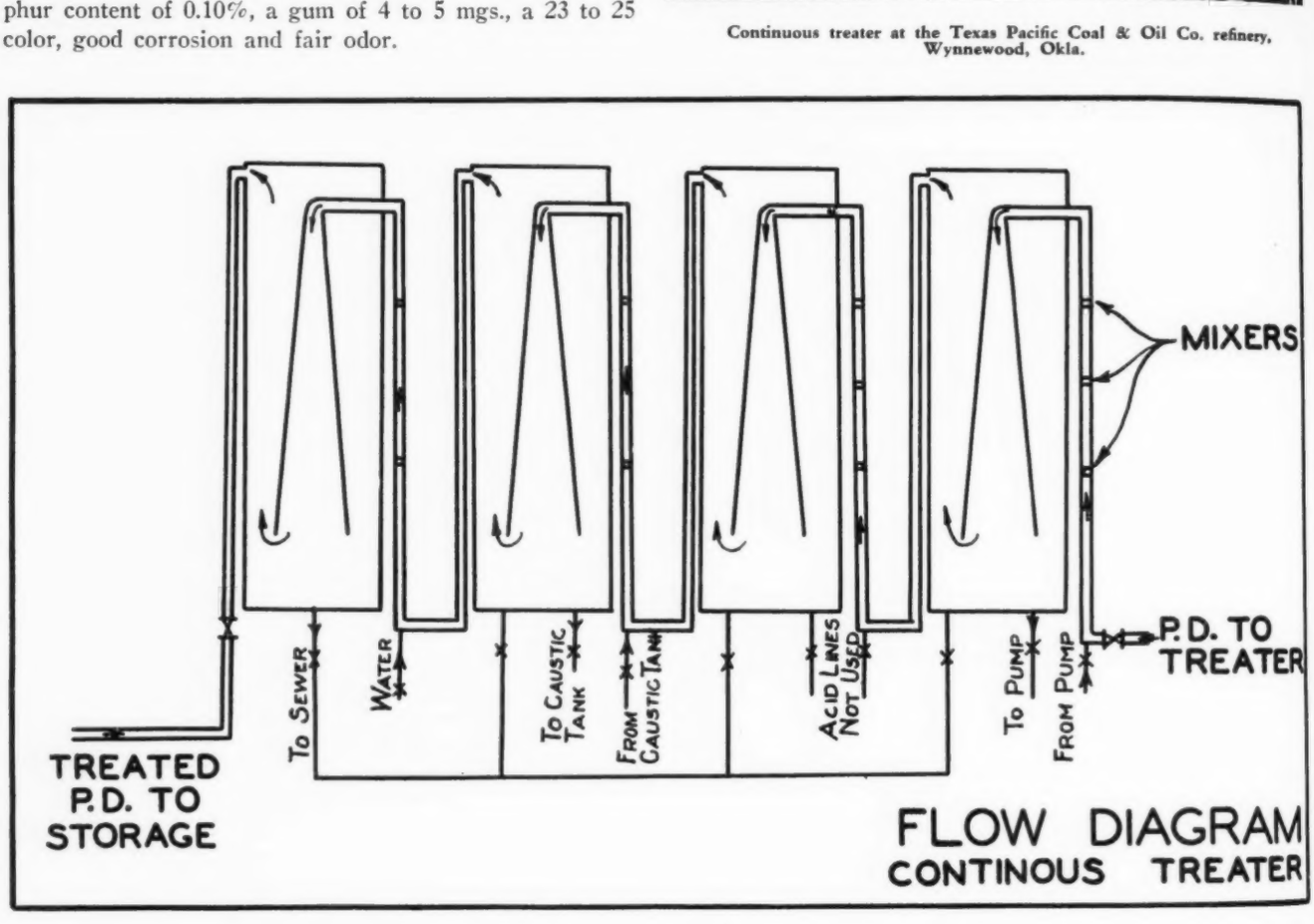
When writing THE ZERO HOUR TORPEDO COMPANY *please mention The Petroleum Engineer*

at this time. The first one was that the older the given batch of caustic, the better. The second was that strong caustic (about thirty barrels) in the bottom of the second drum would prevent the formation of an emulsion in the third, or caustic settler. Why it does this is something we have been unable to determine. Its probable action is to prevent any acid from being in contact with the pressure distillate within a set period of time after the acid treatment, or it may trap heavy asphalt-like particles and hold them because of a lack of motion at this point. Three or four days suffice for the accumulation of about two feet of a heavy, almost solid black tar in this second drum.

The fourth drum is used for a water wash. The water removes quite a quantity of various salts and also prevents caustic emulsions from reaching the rerun stills.

The results with this treater have more than justified the expense. An immense saving in chemicals has been effected. It has been possible to improve the finished product and has simplified the scheduling of material for treatment. The finished product, after rerun, has a sulphur content of 0.10%, a gum of 4 to 5 mgs., a 23 to 25 color, good corrosion and fair odor.

Continuous treater at the Texas Pacific Coal & Oil Co. refinery, Wynnewood, Okla.



Life in Oil Fields Tough on Motor Car

MOTOR cars and trucks lead no soft life in the oil fields of Texas.

Oil production calls for speed and motorized equipment consequently is worked to capacity. Frequently there are no surfaced roads and as extensive production of oil usually is productive also of wet weather, what roads there are soon become bogs under continued rain and traffic. Still the motor vehicle is called upon to convey anything from a 150-pound geologist to a 50,000-pound storage tank—and come back for more.

No statistics exist to show the number of automotive units operating in the oil fields, nor the mileage they roll up in the course of a year, but an idea of the situation may be gained from the records of one oil company. Its 325 motor cars and trucks travel some 3,500,000 miles a year, a distance equal to 135 trips around the world. Operating costs average 8½ cents a mile.

People of Iowa spend six and one-half times as much annually on gasoline as on cigarettes and are taxed nine times as much on the fuel as on the smokes.

B & B Line "spools pretty" on the cable tool rig of Magnolia Petroleum Company's Homsley No. 3, Earlsboro, Okla. Left: Jack Lee, Tool Dresser; Right: R. S. Stanley, Driller.

"Just Naturally A Good Line"

Listen to R. S. Stanley, Driller, calling down Jack Lee, Tool Dresser, for saying they have good luck with their *B & B Cable Tool Drilling Lines:* "Good luck, your eye! It's just naturally a good *line.*"

***Naturally* it is. The wire is specially drawn and put through four very strict tests. It is laid up on machinery designed to impart to the rope that *springy* quality which makes drillers call it "the easiest handling line made—a mighty pretty spooling line that you can count on to drill ahead of the tools."**

Distributors in all fields handle B & B Patentsteel, Extra Strong Cast Steel and Cast Steel *Cable Tool* Drilling Lines, Sand and Pumping Lines, and invincible Yellow Strand Rotary Lines.

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. . . . *The world's largest* spot cotton market . . . . the greatest American inland port . . . . the site of the battle which won Texas' independence, (San Jacinto) . . . the leading Southern convention city and dominant metropolis of the Southwest . . . there is an exceptional hotel of moderate cost.

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TULSA, OKLAHOMA

Possible Utilization of Natural Gas for the Manufacture *of* Chemical Products[1]

By HAROLD M. SMITH[2]

THREE general methods of converting the hydrocarbons in natural gas to other chemical compounds of commercial value, are (1) controlled oxidation—either with steam or by oxygen or air in the presence of suitable catalysts, (2) pyrolysis—the breaking up and recombination of the gas molecules by means of heat, and (3) chlorination—the replacement by chlorine of more or less hydrogen in the hydrocarbon molecules. (See Chart, Fig. 1, accompanying this paper.)

Oxidation

Methane reacts with the steam at 900°C. (1652° F.), in the presence of suitable catalysts to give a mixture containing one volume of carbon monoxide and three volumes of hydrogen.

$$CH_4 + H_2O = CO + 3H_2$$

This mixture of carbon monoxide and hydrogen (water-gas) is the basis for several catalytic syntheses. (1) At high pressures (50-200 atmospheres) and at temperatures of 200°-400° C. (392°-752° F.), in the presence of suitable catalysts water gas yields methanol (methyl or wood alcohol). Methanol finds large uses as a solvent, denaturant and organic intermediate in the formation of other compounds. (2) At atmospheric pressure in the presence of iron or cobalt catalysts many compounds may be formed, among them liquid hydrocarbons and oxygenated compounds which could be blended with gasoline. Acetone, a valuable solvent and intermediate for nitro-cellulose lacquers and explosives may be obtained by a similar process.

Methane, with the proper catalysts and under suitable conditions of temperature and pressure may be oxidized directly by oxygen or air to formaldehyde.

$$CH_4 + O_2 = CH_2O + H_2O$$

Formaldehyde has in recent years become of much im-

[1] Published by permission of Director, U. S. Bureau of Mines.
[2] Assoc. Petroleum Chemist.

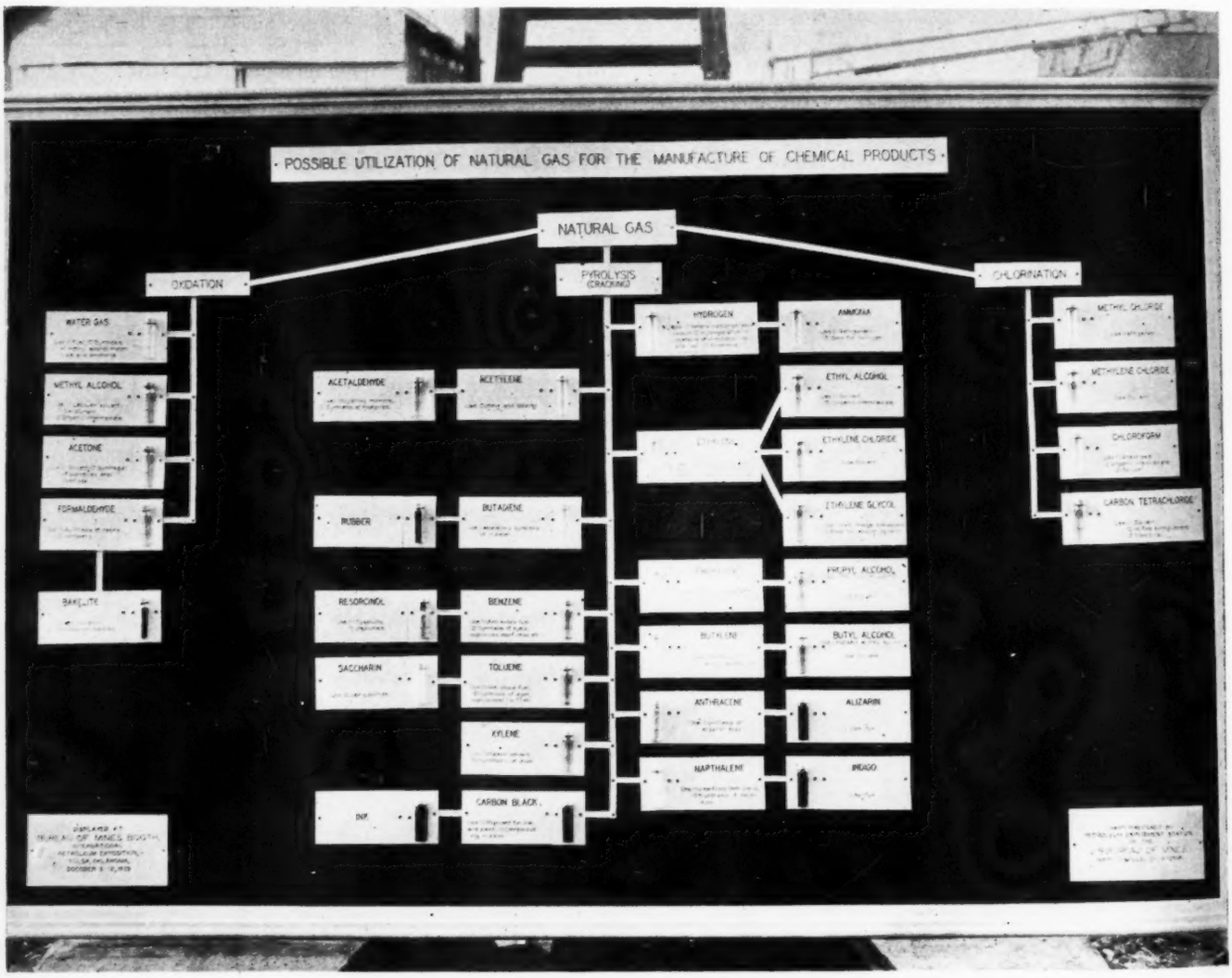
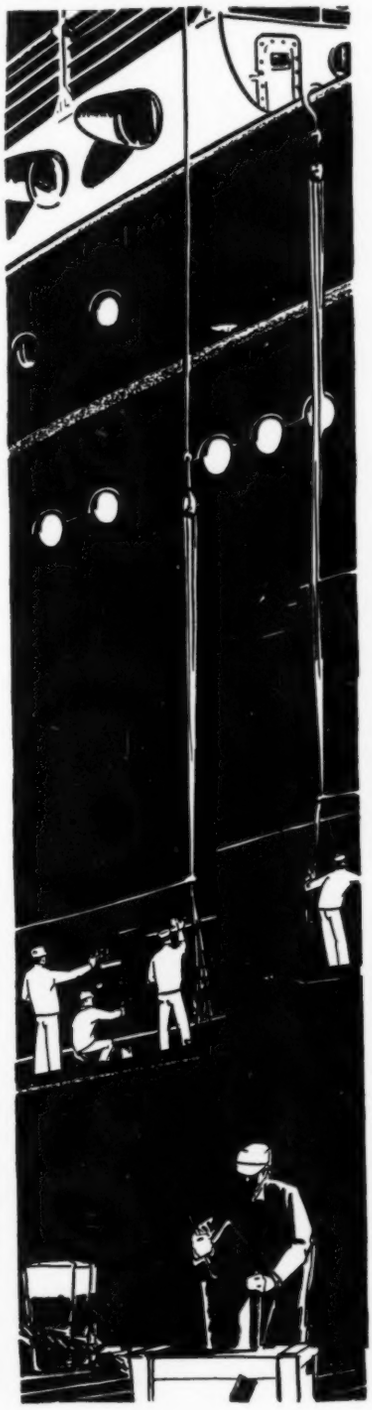


Figure 1—Chart Showing Possible Utilization of Natural Gas for the Manufacture of Chemical Products.

it's the mix that counts



—whether paint or hardfacing

WHY is a ship painted? To check rust and rot...to stop deterioration! And why is only the best paint used? Because it contains the best materials to do the job right. It costs more...but it saves money in the end.

Why are drilling tools hardfaced? To stop rapid abrasion! And why is Blackor used by a majority of operators? Because it contains the materials that give it a super-hardness that resists abrasion from 3 to 5 times longer than ordinary hardfacings and insert materials. Blackor costs more ...but it helps get MORE HOLE.

The manufacturer could change the mix of his paint and use cheap materials and sell his paint cheaper. But it wouldn't do the job right. We could lower the Quality of the ingredients used in Blackor...but it wouldn't do the job right.

So we're maintaining the Quality of Blackor...charging a little bit more... but gaining new friends and new users every day who know it pays to buy Quality rather than a price tag.

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Houston, Texas Office: 616 Public National Bank Bldg.

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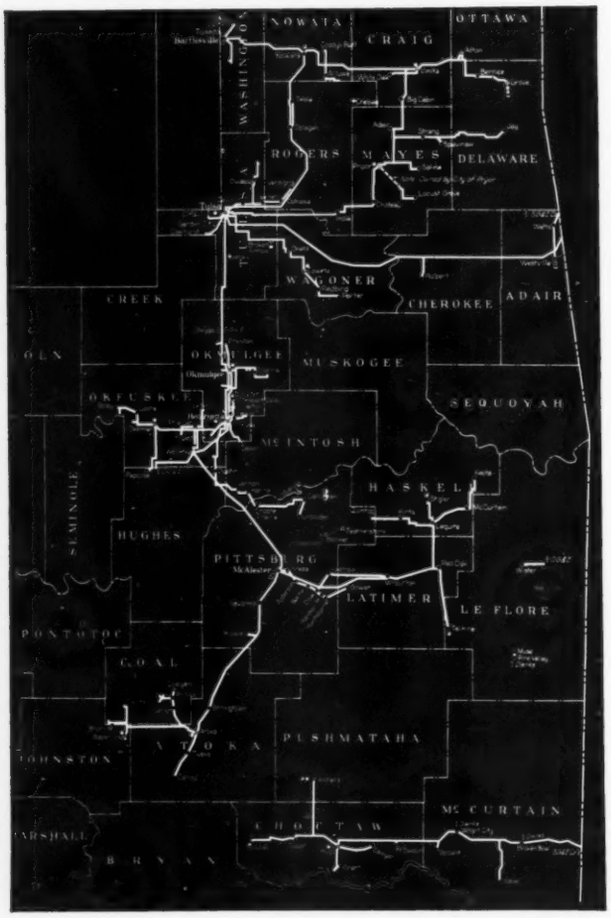
SERVICE



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portance in the synthesis of such resins as Bakelite. It is also a valuable antiseptic.

Pyrolysis

When methane is subjected to temperatures of 1800 to 2200 degrees Fahrenheit it breaks up or "cracks". At slightly lower temperatures the parts reunite, but form new products as they combine. The higher hydrocarbon gases also break up and reunite to give various products different from the parent substances. At sufficiently high temperatures the gas will decompose to carbon and hydrogen.

In either type of cracking hydrogen is always set free and by suitable means can be isolated and used commercially. Its major uses are as a reducing agent in the process industries; the hydrogenation of mineral and vegetable oils and coal; the synthetic production of ammonia and fertilizers, and as a refrigerant.

Other gases formed in the pyrolysis of natural gas are acetylene, butadiene, ethylene, propylene and butylene. Acetylene is used in welding and cutting metal; and may be used to prepare acetaldehyde, which is further used in silvering mirrors or in the preparation of medicinals such as chloral, a soporific. Butadiene, under proper treatment condenses to form an artificial rubber having the same general composition as natural rubber. Ethylene has recently come into use in ripening fruits. It is also finding use as an anesthetic. However, its major use at present is in the synthesis of ethylene glycol, an excellent anti-freeze for water-cooled motors, and the basis for a series of important lacquer solvents. If desired, ethylene may be converted to ethyl alcohol, widely used as a solvent, also in the preparation of other compounds such as ether. Again, by the proper reaction with chlorine, ethylene chloride is formed. This is a valuable solvent, especially for fats and essential oils, and is also used as an anesthetic. Propylene finds use as an anesthetic, and also in the synthesis of iso-propyl alcohol, which is being substituted for ethyl alcohol with good results in certain instances. Butylene is also used in the preparation of certain butyl alcohols which are finding use as solvents in the chemical industries.

The principal liquids formed in the pyrolysis of hydrocarbon gases are benzene, toluene and xylene. Benzene is a very valuable product and forms the basis of many of our chemical processes. Thus we obtain aniline and the entire series of aniline dyes, and many explosives, perfumes and medicinals. In addition benzene is an excellent solvent and anti-knock motor fuel. Toluene is the basis of the familiar T. N. T. (trinitritoluol), of dyes, and of saccharin, a sugar substitute 400 times as sweet as sugar. Xylene is similarly used in the synthesis of dyes and other products, and also to a large extent as a solvent.

The solids resulting from pyrolysis are chiefly naphthalene and anthracene. Naphthalene is well known as an insecticide in the form of moth balls. It is also the basis for the important indigo dyes. Anthracene is used in the synthesis of alizarin dyestuffs. Finally under certain conditions of cracking we obtain carbon black, widely used in making ink, compounding rubber, and as a pigment for paint.

Chlorination

Chlorination is generally applied to methane, although the other gases may be chlorinated. From methane four products may be made: methyl chloride, much used as a refrigerant; methylene chloride, a solvent; chloroform, a general anesthetic, solvent and intermediate in the formation of other compounds; carbon tetrachloride, a solvent, used in fire extinguishers and medicinally in combatting the hook worm.

When writing PUBLIC SERVICE CO. OF OKLAHOMA *please mention The Petroleum Engineer*

Paging Mr. Ripley

THE following is an experience in the Oklahoma-Kansas division of the Continental Oil Co.'s production department which may be interesting to readers of our magazine.

As the result of the completion of the W. Goodrich well No. 1, Sedgwick County, Kansas, which had an initial production of 2,245 barrels in 13 hours at 3,022 feet, operations were started for the drilling of our Westerfield well No. 1, a direct south offset to W. Goodrich No. 1.

A hole full of water was encountered in the Westerfield No. 1 in the horizon from which the north offset (Goodrich No. 1) was completed as a commercial producer. Because of this fact Westerfield No. 1 was drilled to the lower dolomite or a depth of 3,338 feet, where the same swabbed only 172 barrels. Because of this small production it was again decided to deepen Westerfield No. 1 to the Wilcox sand, in which a hole full of water was encountered at a depth of 3,515 feet.

While attempting to plug this well back to 3,338 feet, where the 172 barrels of oil was originally encountered, a fishing job was encountered which allowed a hole full of water to stand on the 3338-foot pay for approximately two months. The well was finally placed in shape to test the 3,338-foot pay, where it produced nothing but water without even a show of oil. Because of this condition permission was asked of our vice-president, E. J. Nicklos, to plug and abandon the well. We were advised to put the well on a long-stroke pump with first-class equipment and give it a thorough test. After pumping approximately 300 barrels per day of fluid which was 100 per cent water for one month, a show of oil was found. This show of oil increased gradually until at the end of two weeks' time five barrels of oil was being produced with 250 barrels of water. At the end of another two weeks the amount of oil had been increased to ten barrels, and at the close of the following month the well was producing 30 barrels of oil per day, which is its present production, and which has been its production for the last three months.

The only moral we are inclined to accept from this story is that we would be very hesitant in asking permission to plug and abandon any well in the future which had any possible chance of making a barrel of oil.

—Reprinted from *Conoco Magazine*.

Believe It or Not

An interesting case of core recovery occurred at the Shell Corporation's well, Blakely No. 1, in the Danbury district, Gulf Coast, Texas. At 3706 feet a core drill was run in sandy shale. After coring five feet the core drill was pulled out, but not a vestige of core was recovered. Running back in the hole again, three more feet of the formation was cored. Believe it or not, on pulling out the core drill the second time, eight feet of good core was recovered. The core must have failed to break off on pulling out the first time and was probably left standing upright, still an integral part of the formation at the bottom of the hole. This would also account for the remarkable recovery of 100 per cent obtained.

Planes Using More Natural Gasoline

AIRCRAFT are assuming a position of some importance as large scale consumers of natural gasoline, that is, gasoline recovered from natural gas. The demand from this source is growing as rapidly as the aviation industry.

Another source of increasing consumption, the U. S. Department of Commerce reports, is the export trade, the practice of shipping natural gasoline in bulk by tankers to foreign countries being on the increase.

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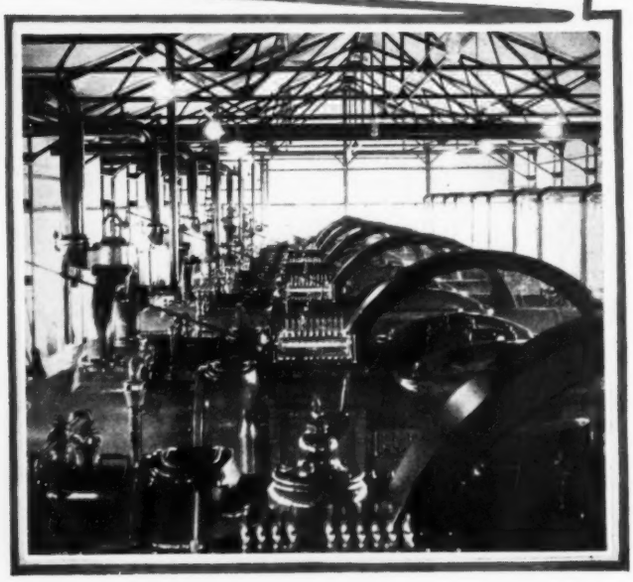
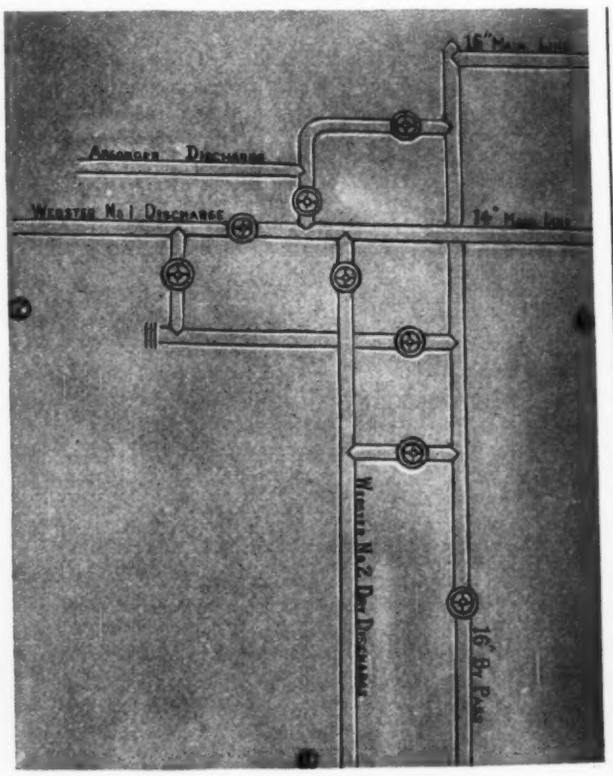
This Station Has Metal Valve Chart Oriented *to* Line Layout

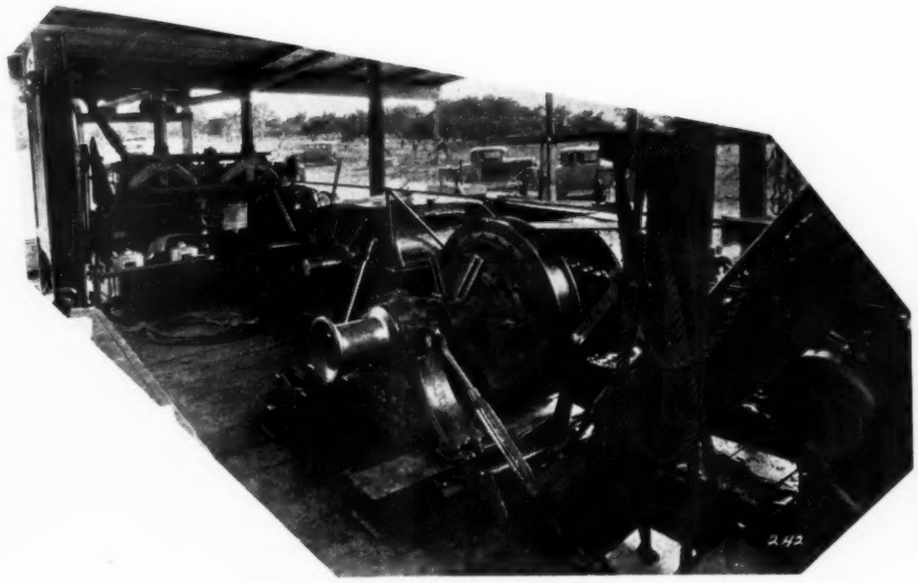


MANY types of gate valve charts at pipe line stations are found in various sections, but one of the most unique is a metal chart oriented to the layout and which is installed horizontally. Blame for closing or opening the wrong gate is sometimes traced to confusion on the part of the operator who failed to orient himself properly to a chart that was probably tacked vertically on a board. There are several different methods of setting charts vertically in either stationary or folding stands outdoors, but sooner or later the elements make the chart illegible.

The metal chart shown in the accompanying photograph was built at the Magnolia Gas Co.'s Sarepta, Louisiana, gas station. When the operator is looking on the chart and finds the valve he is searching for, he can glance straight ahead or slightly to either side and see the valve he desires to operate. It is practically impossible to study the chart carefully and then go to the wrong valve. The chart itself is a copper plate with the entire manifold layout chiseled in it and therefore it is not readily blurred or otherwise affected by weather conditions.

The all-weather chart is bolted to a piece of sheet metal to give it a strong base and this assembly is welded to a short length of two-inch pipe. The end of the pipe which is welded to the assembly was split down the sides in four places and the straps were flattened and then welded to the bottom side of the assembly. A short nipple was set in concrete near the gates and the gate chart and its pipe stand was screwed into the nipple tightly and oriented to the gate valve.





Drilling with Natural Gas or Gasoline Rigs *Is More Economical*

With the coming of Portable Rig Company's 5000-foot portable drilling units a new peak of efficiency and economy has been attained. Economies in transportation, operation, performance, and maintenance, greatly favor these rigs when compared to other type units.

Transportation of these rigs is an easy problem. They may be moved in individual units on an ordinary oil field truck. This feature permits moving into and setting up on locations practically inaccessible to other rigs.

The natural gas or gasoline consumption of these rigs is very small. Either of these fuels may be transported to the rigs at a minimum cost. The only water required is for use in the radiator.

Superior construction and utilization of finest materials assures strength and long life. They are made entirely of steel with all parts subject to strain and severe wear strongly re-inforced. Due to the high standard of construction, cost of maintaining these rigs is kept to the lowest possible minimum.

These Rigs are powered by Waukesha Engines with power transmitted to the draw works through a reverse clutch unit especially designed by us for this character of work. The clutch unit is carried between two box type steel pedestals, each equipped with double Timken anti-friction bearings. It is equipped with split type steel sprocket or pulley, making the rig adaptable for rotary or cable tool drilling.

Portable Rig Company's 5000-foot drilling units are made in two types.

Bulletin No. 500 describes the EXTRA HEAVY TYPE, which is powered by a 300 H. P. Waukesha Engine.

Bulletin No. 300 describes the HEAVY DUTY TYPE, which is powered by two 125 H. P. Waukesha Engines.

We will gladly send either or both bulletins on request.

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HOUSTON, TEXAS

When writing PORTABLE RIG CO., INC., *please mention The Petroleum Engineer*

A Differential Regulator

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IN THE conservation of our natural gas by mixing with coke-oven gas, this regulator is destined to have a place of importance.

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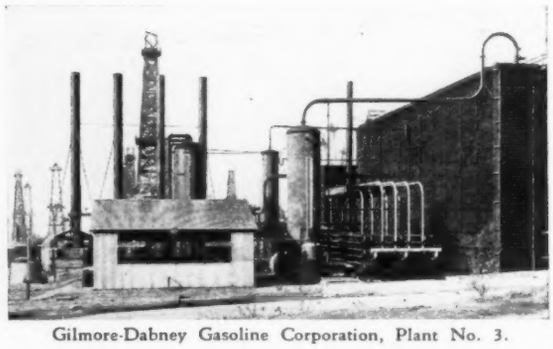

Gilmore-Dabney Gasoline Corporation, Plant No. 3.

The Newest Baby Always the Best

CAMPBELL'S latest construction job, here shown, is just a little newer, and so a little better than any of the many plants they have yet built. This installation has the following new features:

1. Campbell Cooling Units—one more stride in cooling efficiency, lowering the oil temperature another few degrees.
2. Double-Section Cooling Pond—hot water in one section, cold in another—speaks for itself.

Construction time—33 days from scratch to gasoline. This constitutes a time record in efficient plant construction. Campbell engineers are ever striving not only to lower their time records, but to add one more touch that will make their latest plant their best.

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Average Citizen Is Dependent on Oil Lubrication

THE average citizen has small conception of the extent to which he is dependent upon lubrication. His clothes are machine woven and machine sewed only because lubricants have made possible the development of high-speed machinery for the work. He has running water in his home only because means have been found to lubricate pumping machinery. Electricity is his at the turn of the switch because lubricants have been developed for the high-speed machinery necessary for its production, and because other petroleum products have made possible the transmission of the current over long distances.

His automobile could run only a few feet without lubrication—and lubrication of a highly specialized kind. Railroad trains could not operate at any speed comparable with modern conditions had not suitable lubricants been devised for the fast-moving parts. The safety devices which make modern railroad travel safe would be inoperative without lubrication.

Without lubrication, and particularly modern petroleum lubrication, elevators could not run. Electric signs would be unable to flash their advertising messages. Printing presses could not run, and linotype machines could no longer make type slugs. Practically the only kind of work that could be accomplished in any industry would be that which could be performed by manual operation of the most simple devices.

Nor is the petroleum lubricating industry looking at today alone. All over the country, wherever there is an organization concerned with the manufacture of lubricants on a large scale, scientists are working in well-equipped laboratories and conducting tests in the field. They are working not only to provide the best of lubrication for the machines of today, but to make the progress that is necessary today in order to meet the lubrication needs of tomorrow.

Airplanes Common in U. S. Oil Fields

AIRPLANES are becoming almost as common as derricks in the oil fields of America.

Widespread use is being made of the airplane for oil field exploration. A geologist, traveling by air, within a few hours can study hundreds of square miles of territory he could not hope to penetrate on foot or horseback in months, if at all. Moreover, he can obtain a series of accurate photographs which enable him to make a more exhaustive study of the terrain than ever before was possible.

Where once the development of a new oil field called for highways and railroads, now the oil man frequently thinks first of laying out an airport. Especially in the plains country airports are an almost necessary adjunct of the oil field. Drilling supervisors and contractors find the plane speedy and economical in traveling between widely separated development projects. Planes carry repair parts in a fraction of the time it would take to convey them by any other means. The possibility of getting drilling reports back to the main office daily and within a few minutes is another advantage.

Even refiners are finding air travel a business aid. Not only do planes afford opportunity to test fuels and lubricants, but they transport executives to whom time means money and salesmen who must cover much ground within a short period. Some oil companies have equipped large planes as traveling offices, carrying not only an executive and his staff, but the entire headquarters staff, and sometimes the board of directors, between the various properties.

Oil men regard the airplane, like their ground automotive equipment, as useful and valuable machinery meriting the best of care. Consequently they figure on getting 50,000 to 100,000 miles of use from the machines and estimate their operating cost at about 15 cents a mile.

Merco Nordstrom Awards Slogan Prizes

Indicating the intense interest aroused by the recent slogan contest held by the Merco Nordstrom Valve Company, 11,275 slogans were received by the manufacturers over a period of approximately sixty days, according to H. S. Shuey, secretary.

The Merco Nordstrom Valve Company offered $500.00 in prizes for the best slogans pertaining to Nordstrom valves and contributions were received from every state in the Union and several hundred from foreign countries.

The majority of slogans were sent in by employees and officials of industrial concerns.

The jury of awards exercised great care in checking over the mass of slogans and each was read by the jury and given consideration. From more than eleven thousand, nineteen were finally selected for the prizes. The Grand award was given to Mr. J. L. Pillow, of the Standard Oil Company, Baton Rouge, La., who contributed the following slogan: "Nordstrom—The Perfect Application of a Principle".

The second award was made to Mr. G. E. Genung, 13326 Terry Ave., Detroit, Mich., the slogan being "Hydraulic Lubrication Insures Effective Manipulation".

The remaining seventeen slogans selected in order of their preference were as follows:

Fabricated and Lubricated for Long Life—G. C. Bemis, Jr.

Won't Leak, Won't Stick, Lubrication Does the Trick—T. S. Barlow.

The Valve Controls the Flow, the Screw Controls the Valve—Henry A. Webber.

The Turn of a Screw Pushes Lubricant Through—Hal D. Draper.

Nordstrom's Perfection is Your Protection—Russell Egbert.

For Those Whose Goal Has Been Control—Arthur Atkins.

Nordstrom's Lubricated Action is the "Seal" of Satisfaction—S. St. Claire.

Bringing Pressure to Bear on Valve Troubles—Albert S. Eggleton.

Will Stand the Strain on Any Main—Fred J. Maples.

Simple to Lubricate, Easy to Operate—G. W. Martindale.

They Lubricate As They Operate—Edith M. Bell.

Loosened and Tightened by Lubricant—L. D. Nicolson.

Where Nordstroms Go in Troubles Go Out—E. J. Shaunce.

With Every Connection Comes Your Protection—C. G. Schram.

Once Installed Never Stalled—Charles W. Smith.

Made Their Way By the Way They're Made—E. D. Murphey.

Satisfaction at Every Turn—Clair Wilkes.

O. C. Has a Freak Well

THE Prairie Oil and Gas Company and Tom Slick No. 2 Hiddleston, in the southeast corner of 19-11-2w, in the Oklahoma City field, began flowing into the tanks after it had been shut down and temporarily abandoned for a long time.

The well is located in the extreme eastern part of the field, had a hole full of water and after drilling to 6,858 feet, the operators made every effort to produce the well. Connections were made and then forgotten. It made 170 barrels of oil in 24 hours.

Annual production of petroleum asphalt in the United States has more than doubled in a decade.

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The Busy-Bee Tool in the Oil Country and the Handiest

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KEEP an "Anchor" Puller-jack handy at every job. One man shifts or lifts heavy machinery, yanks out mired motor trucks, pulls and lines up pipe, tightens guy lines, pulls boiler tubes, pulls belts for splicing, speeds up construction and erection work. Positive action, fool-proof, operates in any position.

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Sheave block included

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Turbo-Rotary Drill Tested *in* Oklahoma

THE hydraulic turbo-rotary drill, a new method originating in Russia, is now being tried out in two different fields of Oklahoma. The novel features of this method are:

The application of the moving power is transferred from the surface of the ground to the bottom of the drill hole—or, in other words, to the bit.

The energy necessary for moving the motor is transmitted hydraulically, in the same way as it is done in any system of hydraulic drilling. The drilling instrument (bit) is united with the axis of the drilling apparatus, being attached to the bottom of the drill pipe. The drilling apparatus consists of a cylindrical tube, inside of which there is a correspondingly constructed hydraulic motor. The liquid, water, or mud fluid, which is pumped through the drill stem into the hole, performs the function of carrying the cuttings out of the well, and has to pass through the hydraulic motor which rotates the axis of the apparatus and the bit. The axial or bit pressure necessary for drilling is created by the weight, or a part of the weight, of the drill pipe which connects the apparatus.

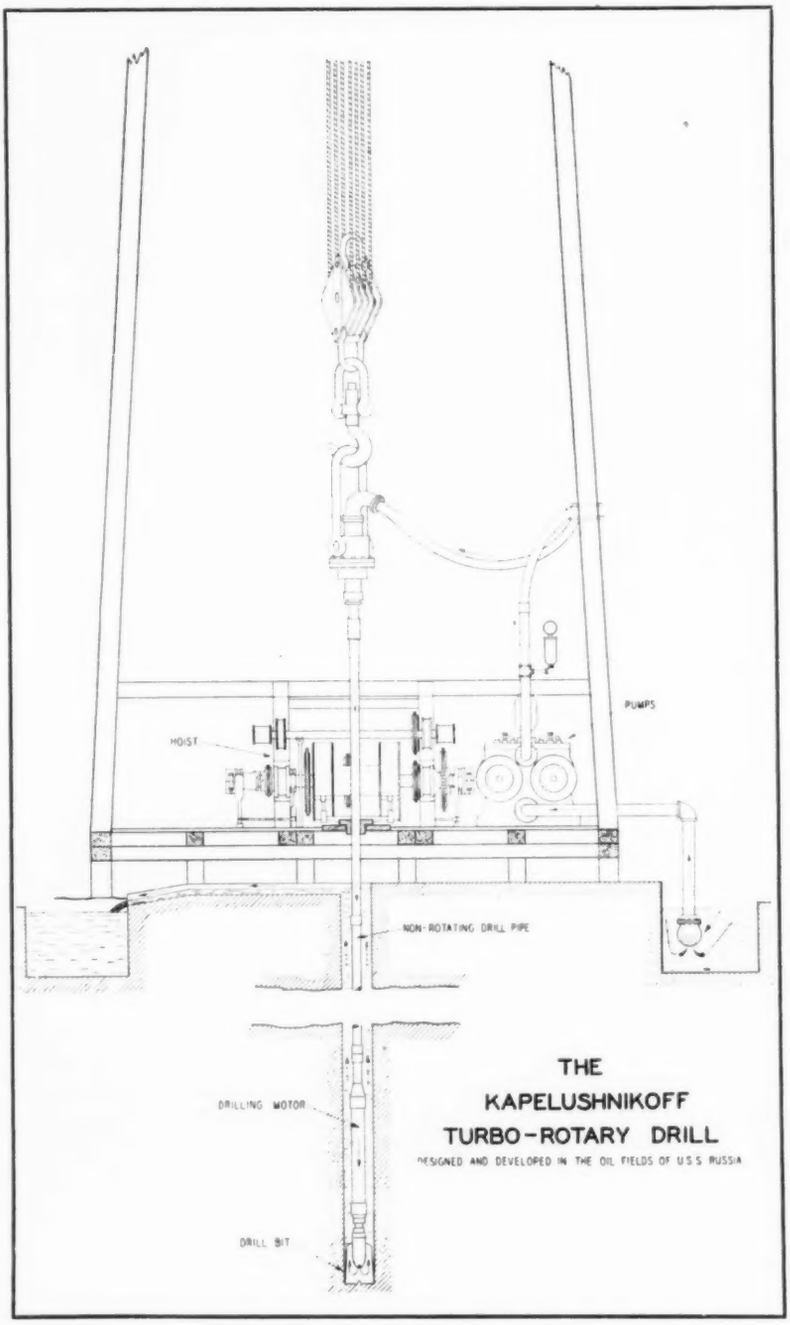
The drilling is done without any rotation of the drill pipe.

Because the drill pipe in this new system of drilling has to furnish resistance only to the comparatively light action of the motor, and serve principally for the transmission of the liquid to the motor and to the bottom of the well, it is possible to use a much lighter weight drill pipe of reduced wall thickness.

The operation and efficiency of the hydraulic motor in the well is independent of the depth, because this work depends only upon the difference of the weights between the columns of liquid in the well.

The first experiments with drilling by this system were carried on in 1924-25 in the Surakhany field in camp No. 6, well No. 7,648. At the beginning the drilling proceeded slowly, due to various initial difficulties unavoidable in the early stages of development of any new apparatus.

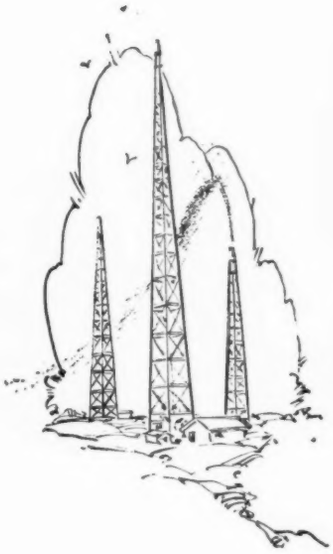
In 1926-27, 13,500 feet were drilled by this method; in 1927-28, 22,000 feet, and in 1928-29 the footage drilled was 40,000 feet. The results of turbine drilling have developed many novel bits of information pertaining to the idea and principles on which this method is based.

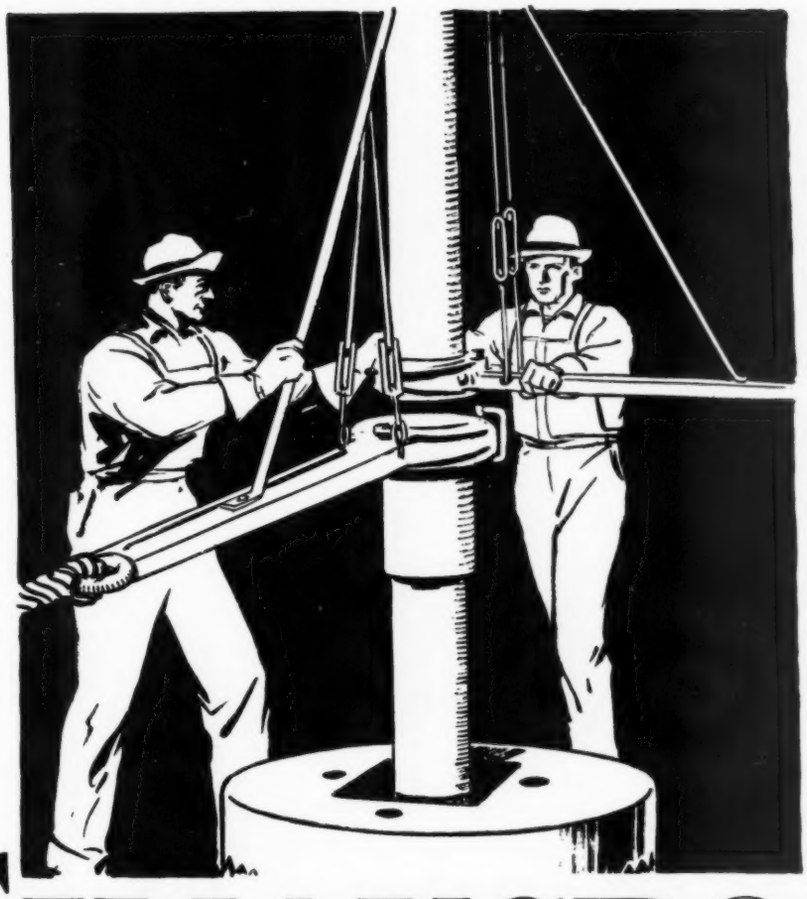


THE KAPELUSHNIKOFF TURBO-ROTARY DRILL
DESIGNED AND DEVELOPED IN THE OIL FIELDS OF U.S.S. RUSSIA

PARAFFIN DEPOSITS IN OIL WELLS

THE study of deposits of paraffin in oil wells being conducted by the Laramie (Wyo.) field office of the United States Bureau of Mines, Department of Commerce, has been directed to obtain better and cheaper methods for removing paraffin from oil wells and methods of preventing its deposition. A study has been made to determine the action upon paraffin of different solvents and the degree of solubility of paraffin in petroleum ether, natural gasoline, kerosene, straw distillate, refined mineral oils and crude oil. The plotted curves show that the solubility of wax or paraffin in hydrocarbon products increases as the solvent becomes lighter until a point is reached where the solvent contains a large amount of butane and propane. Data have been obtained also on the melting point, index of refraction, molecular weight, and other properties of different wax fractions.





SIMANCRO!

A High Tensile Seamless Casing—made from an Alloy Steel which combines the essential requisites of strength and toughness—VITAL wherever the hazards of deep drilling are encountered.

Over a million feet have already been used in the Oklahoma City and Kettleman Hills Pools without a single failure.

"SIMANCRO" is an exclusive product of this company—its use is your best insurance against casing trouble. Available in 95,000# and 110,000# minimum tensile grades.

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SPANG WELDED *and* STANDARD SEAMLESS

OIL COUNTRY TUBULAR PRODUCTS

Airplane Finds Bad Pipe Line

BREAKS in a pipe line, it seems, invariably happen at the wrong time and no one yet has heard a true pipe liner relate a yarn about a break happening in balmy weather, in a readily accessible place and in the daylight hours of the morning. Such things just don't happen. But during a sleet or snow storm and when the temperature skids below the goose-egg mark the pipe liner has a feeling of "relieved disappointment" if he is not called in the coldest hours of the night.

After the snow melted, the ground was soft, as the driver of this tractor discovered

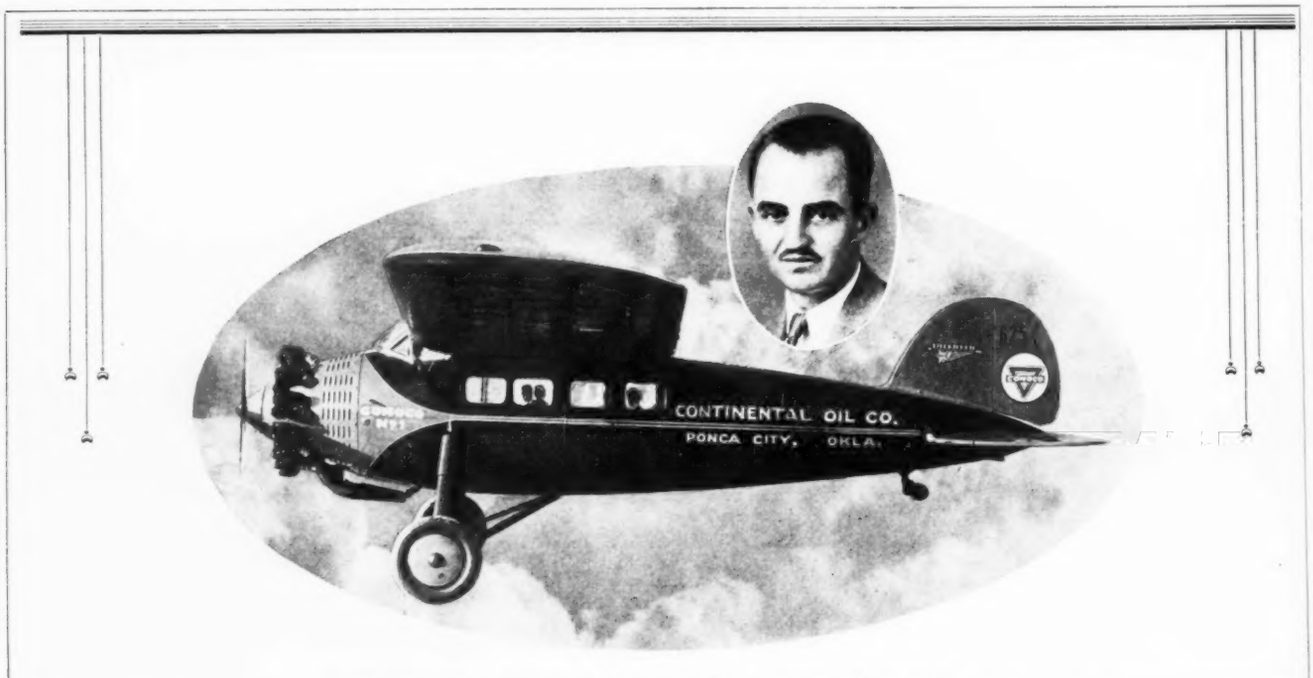
The storms and freezes of January caused every section of the Mid-Continent difficulties with line breaks. Out of this came another practical use for the airplane and the line walker has hopes of abandoning his time-honored discussions concerning the reckless claims stated in catalogues anent waterproof boots and shoes. His thoughts are flying into the future when he will have the more glorified title of probably "flying break detector" and then his discussions will be more about the new type of plane purchased by the company which he will occasionally use.

The plane proved a welcome gift to the Kansas Osage Gas Co., subsidiary of the Continental Oil Co., on a day when the mercury was subzero and snow drifted from 10 to 15 feet in places along its right-of-way. With its use a break that, with ordinary methods, would have required 10 to 12 hours to find, was found in the amazingly short time of 14 minutes.

This company has a 10-inch main line system running from Greyhorse compressor station in the Osage hills of Oklahoma, operating at a pressure of 280 pounds. The line is built through rugged country with 40-foot coupled joints.

Soon after daylight, on this coldest of days, the engineer at the station reported trouble on the line when his pressure gauge dropped back. Necessary switches were made on the remainder of the company lines drawing gas from other fields and service was not interrupted. The snow had drifted badly during the night and few roads were even tracked at that hour.

D. C. Williams, manager of the Continental's gas department, and Al Janke were in the Ponca City office discussing the best means of finding the break. It would be hours



The plane which found the pipe line break, and its pilot, Frank M. Hover

Break When Snowstorm Stops Walkers

before the line walkers, wading through drifted snow, could find it, and more hours to get to a phone to report the location. Furthermore, the condition of roads and location of drifts would have to be learned. Janke, who had never been in a plane, suggested searching for the break from the air. He was certain of finding the line and following it because he had been over the ground so many times.

Frank M. Hover, one of the Continental pilots, was called, and, while he was determining whether he could get a ship off the ground, a map was sketched, marking the route to be flown. Finding the snow not too deep at the airport, Hover telephoned his readiness. A few minutes later Williams ordered the compressor station started, so more dirt from the ditch would be churned into the snow, discoloring it, and Janke left with the pilot.

Fourteen minutes after taking off the break was discovered. A black spot on the ground where the dirt had churned marked the spot. The plane flew on to the compressor station and circled, signaling the station to shut down and informing the waiting crews the break had been found. Then Hover and Janke started searching out the best route to send the crews over to reach the break. The few trails that had been broken were found and noted and the ship headed back to the airport.

Telephone orders were given for the crews to start over trails selected from the air. Truck drivers were able to get their loads of tools and equipment to within a mile and a quarter of the break and then crew members carried equipment the remainder of the way over hills, through drifts and across ravines to the trouble.

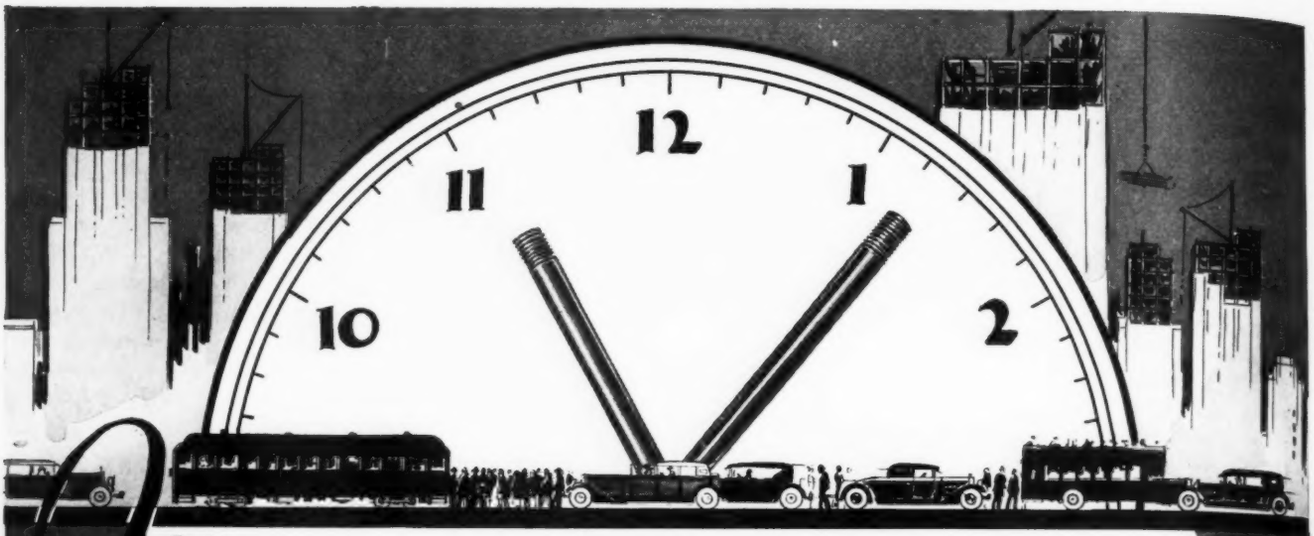
A bell hole four feet by four feet was dug and the break found at the coupling. The ditch was opened one full joint to permit the pipe to be raised. As a tripod was too difficult to bring in, a piece of 4-inch pipe was placed across the ditch and, with tongs, the joint raised high enough so a long sleeve could be slipped over the end.

When the pipe was lowered and the sleeve slipped over the other loose end and Janke certain a tight coupling was being made, he dispatched a man to order the compressor station started and valves opened. Early that night the line was blown and put back in service less than 12 hours after finding the break.

When melting snow made the ground too soft for ordinary transportation, the ox-drawn mud scow was called into play

In the southern states of the Mid-Continent area the snowfall was not as heavy and the weather not so severe, yet the swamp country traversed by lines offered its problems and the old stand-by in such emergencies, a bull team and mud sled, were once more pressed into service.

The line break soon made a dark spot on the snow-covered horizon which was easily observed from the airplane



Minutes LOST mean DOLLARS LOST!

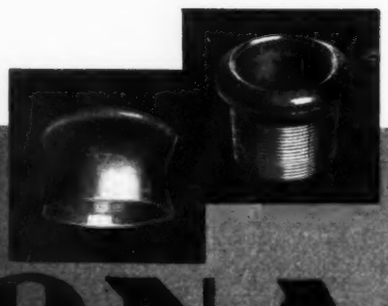
Nowadays when new pipe arrives at the job with battered ends and burred threads causing rethreading and unproductive labor, WHO IS TO BLAME?

Of course the threads *were* in perfect condition when they left the pipe mill but the pipe was *not* Colona Protected.

Colona Pipe Thread Protectors are now known and immediately available to all pipe manufacturers. They are patented—the only protectors that give 100 percent protection to the pipe ends, threads and couplings.

The simplest, most certain way of eliminating new pipe thread trouble is to SPECIFY COLONA PROTECTED PIPE in your order requisitions.

PITTSBURGH SCREW & BOLT CORPORATION
Colona Division · Pittsburgh, Pa.



COLONA PIPE THREAD PROTECTORS

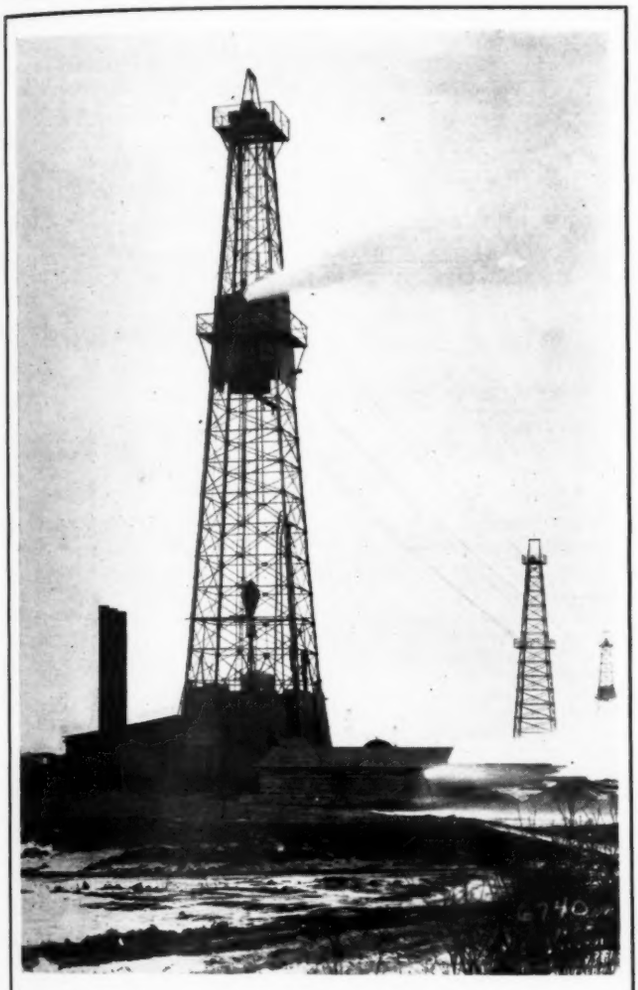
When writing COLONA DIVISION, PITTSBURGH SCREW & BOLT CORP., *please mention The Petroleum Engineer*

Weather Causes

Unusual Conditions *at* Oklahoma City

THE Oklahoma City oil field, located on the outskirts of that city, within rifle shot of the capital of the state, has caused many innovations in the drilling practice which previously characterized activities of the Oklahoma fields, and hardly a week passes that some new problem of operation is not confronted to additionally complicate the duties of the officials in charge of the field.

This field, which now has a potential production of around 500,000 barrels daily, added 2,300 feet to the depth of the rotary holes which were drilled in the Greater Seminole area, and caused many worries over the proper mud-laden fluids as a starter. After much progress was made in the solution of the mud-fluid problems, the heavy pressures which marked the initial production of unusually large wells played havoc with many of the fittings, cutting out in a remarkably short time fittings which were made of the best material obtainable.



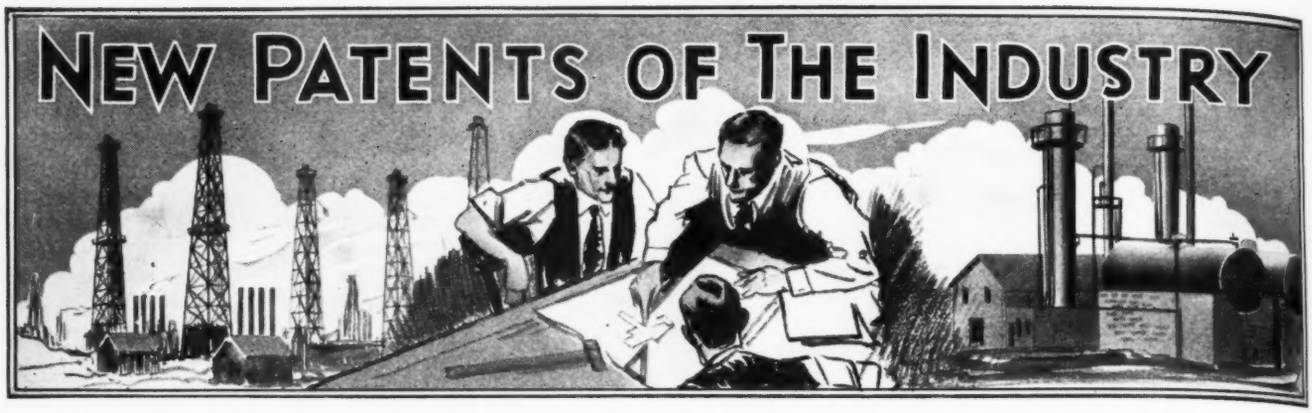
Fourble board equipped with steam for the derrick men.

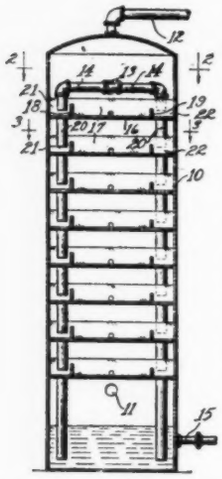
Just to add to the difficulties in the field, the unprecedented weather conditions experienced during the month of January caused more grief. The field attained a minimum temperature of 15 degrees below zero and this temperature was accompanied by a foot of snow which clung tenaciously to the ground for three weeks. In sunny Oklahoma the rotary crews are not accustomed to running during weather of this sort, and so the rigs were remodeled for conditions which at least permitted the crews to work in comfort. It was not so bad for the members of the crews who were on the derrick floor, as the ordinary rig permits steam heat for them; but the severe weather necessitated additional protection for the derrick men. As will be noted in the accompanying picture, the fourble board was housed in with inch sheeting and a branch of the steam line carried up that high in order to provide sufficient heat for the men to work.

The illustration in the lower right hand corner of this page gives an example of another condition which was met and conquered by the Indian Territory Illuminating Oil Co. in the Oklahoma City field. The scene shows a slush pond of unusual construction and design, and it was necessitated by a lack of area on the drilling site. This particular well was located on the edge of a creek, and there was not sufficient room to spread the slush pond over the necessary space. After considering the problem the officials of the company decided that, since the pond could not be spread out over the regular area, this could be made up by digging it to a much greater depth. The slush pond attained a maximum depth of thirty feet.

Slush pond 30 feet deep.

NEW PATENTS OF THE INDUSTRY





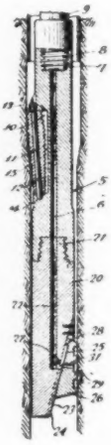
1,738,870. APPARATUS FOR THE SEPARATION OF HYDROCARBONS. EDWIN R. COX, Venice, and HOWARD S. COLE, JR., Los Angeles, Calif., assignors to California Petroleum Corporation, Los Angeles, Calif., a Corporation of California. Filed Dec. 1, 1927. Serial No. 236,997. 5 Claims. (Cl. 261—113.)

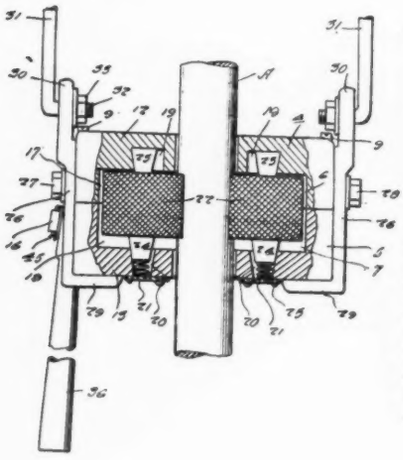
1. A tray of the character described comprising a bottom, a central division wall; two distributing dams, one each on opposite sides of said wall and spaced along the length thereof to form diagonally disposed intake reservoirs, two liquid level maintaining dams, one each on opposite sides of said wall forming diagonally disposed discharge reservoirs, there being absorption reservoirs formed intermediate said distributing and liquid level maintaining dams one on each side of said wall with perforate bottom sections.

1,738,860. HYDRAULIC ROTARY UNDERREAMER. WILSON B. WIGLE, Los Angeles, Calif. Filed June 11, 1927. Serial No. 198,117. 12 Claims. (Cl. 255—74.)

1. A rotary hydraulic well reaming tool comprising a cylindrical body member provided with a watercourse, a reaming cutter mounted on said body member adapted to engage with the wall of the well, and a hydraulically operated shiftable bearing member secured to the body member for forcing the reamer cutter into cutting engagement with the well wall, said shiftable member having a fluid port adapted to register with the watercourse of the body member when said member is shifted.

12. In a well reaming tool, a cylindrical body member having a watercourse therethrough, a reaming cutter secured to said body member for enlarging the bore of the well as the drilling progresses, a wall bearing shoe shiftably mounted on the lower end of said body member having a bore adapted to register with the watercourse of the body member when brought into operative position, said shoe having a recess on its inner face above the bore, whereby when fluid pressure is introduced through the watercourse of the body member the shoe will be shifted upwardly into operative position with the wall of the well, the fluid pressure maintaining the shoe in said operative position during the operation of the reaming tool.

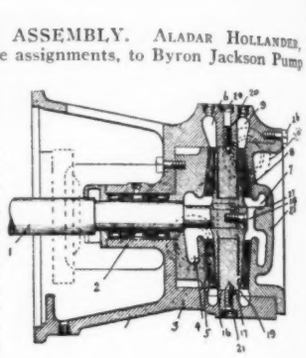




1,742,302. ROD CLAMP. SAMUEL S. BRADSHAW and CHARLES ALBERT MARTINDALE, Seminole, Okla. Filed Apr. 14, 1928. Serial No. 270,047. 6 Claims. (Cl. 294—91.)

1. In a clamping device for pump rods, a pair of complementary jaw members hingedly secured together at one end, means for locking the free ends of the jaws together around a pump rod, rollers mounted in the jaws for engagement with the pump rod, and suspension means attached to the jaws.

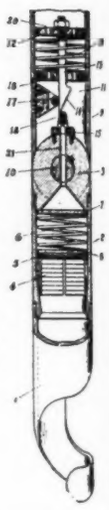
1,743,348. CENTRIFUGAL-PUMP ASSEMBLY. ALADAR HOLLANDER, Berkeley, Calif., assignor, by mesne assignments, to Byron Jackson Pump Co., a Corporation of Delaware. Filed May 7, 1928. Serial No. 275,795. 2 Claims. (Cl. 103—109.)



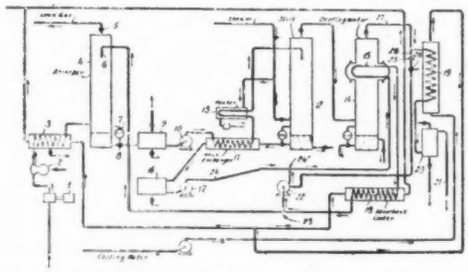
1. In a multi-stage centrifugal pump, of relatively high and low stage fixed together, a plurality of integrally formed impellers, a sectionalized diaphragm assembled between adjacent impellers, an integral annular pump casing within which said impellers and said diaphragm are mounted, an annular joint between said casing and said diaphragm and wedge means between said diaphragm and said casing adapted to hold said joint tight.

1,738,819. OFFSET OVERSHOT TOOL. GUSTAVE J. CORMIER, Seminole, Okla. Filed Sept. 27, 1927. Serial No. 222,321. 5 Claims. (Cl. 294—86.)

1. An offset overshot tool comprising a wall hook, a slip casing rising from the hook, slips in the casing, a hinged joint on the upper end of the slip casing, a tubular section, hinged to said joint, a piston in said tube operable by the drilling mud pressure, a rod dependng from said piston, a wedge on the bottom of said rod, said wedge being adapted to engage the joint to swing the same to one side and extend the hook and slip casing at an angle to the tubing.



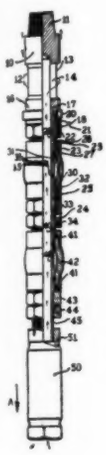
1,743,568. TEMPERATURE-CONTROL SYSTEM FOR DEPHLEGMATORS. JOSEPH PRICE, St. George, N. Y., assignor to The Griscom-Russell Company, New York, N. Y., a Corporation of Delaware. Filed Aug. 14, 1926. Serial No. 129,158. 3 Claims. (Cl. 196—8.)



1. Apparatus for dephlegmating, comprising a still for producing a mixture of vapors, a dephlegmator connected thereto and having a cooling coil, a storage tank receiving cooling medium from said still for said dephlegmator and having its inlet connected to the still and its outlet connected directly to said dephlegmator cooling coil inlet, and a cooler having its inlet connected to the outlet of said dephlegmator cooling coil, and having an outlet, a shunting conduit connected across the outlet end of said cooler and the inlet end of said dephlegmator cooling coil, and a device in said conduit responsive to changes in the temperature of said dephlegmator for controlling the temperature of said dephlegmator.

1,732,499. APPARATUS FOR SEPARATING GAS FROM OIL AND WATER. Victor F. Chancellor and Sebastian L. Calvert, Bristow, Okla. Original application filed Jan. 5, 1926, Serial No. 79,461. Divided and this application filed June 11, 1926. Serial No. 115,302. 4 Claims. (Cl. 103—220.)

1. An apparatus for separating gas from a combined body of gas, oil and water comprising a casing closed at its lower end and adapted to be suspended from and closed at its upper end to the working barrel of a well pumping apparatus, a tubular element suspended from said casing, closed at its lower end and having its upper end closed by the bottom of said casing, a conducting pipe common to oil and water and leading from said element, through said casing to said working barrel, said casing provided above its transverse median with circumferentially disposed inlets for a combined body of gas, oil and water, the upper portion of said casing providing a passage for the upward flow of the gas separated from such combined body, oil and water carrying off means within said casing and opening into said element for elevating and lowering the level of the oil within the casing to provide for the agitation of the liquid to assist the gas to rise to the level of the oil, and said casing having its upper end provided with outlets for the discharge therefrom of the separated gas.

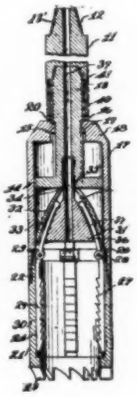


1,743,937. SWAB. Harvey R. Standlee, Tulsa, Okla., assignor of one-fourth to Paul Arbon Company, Tulsa, Okla. Filed May 15, 1929. Serial No. 363,266. 3 Claims. (Cl. 74—109.)

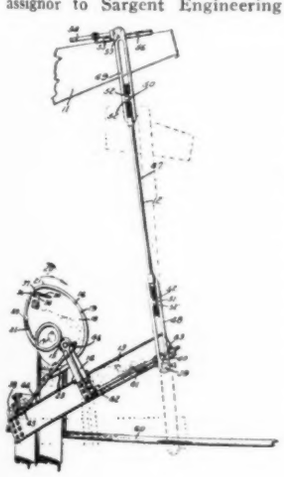
2. A swab comprised of a body member having a hole therethrough, heavy stiff packing encircling the swab near its top, flexible packing encircling the swab below its top, said body member having an opening leading from its interior hole to a point behind the last mentioned packing whereby the fluid load on the swab will cause it to expand.

1,742,767. SHROUDED ROTARY FISHING TOOL. Jess W. Hughes, Long Beach, Calif. Filed Aug. 10, 1927. Serial No. 211,941. 14 Claims. (Cl. 294—116.)

1. A fishing tool comprising in combination a tubular casing open at its lower end, a plurality of arms pivotally mounted in the casing having gripping jaws, a movable means operating longitudinally in the casing having a space to accommodate the upper ends of the said arms, the movement of the said means downwardly spreading the jaws apart and upwardly pulling the jaws together and means releasable from a remote point for holding said movable means stationary within the casing.

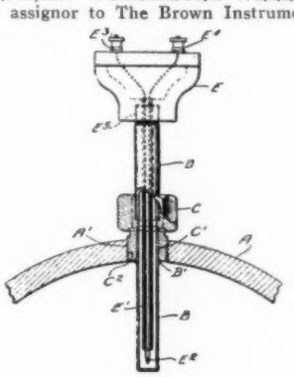


1,742,486. PUMP JACK. Sumner B. Sargent, Los Angeles, Calif., assignor to Sargent Engineering Corporation, Los Angeles, Calif., a Corporation of California. Filed Jan. 14, 1925. Serial No. 2,391. 11 Claims. (Cl. 74—14.)



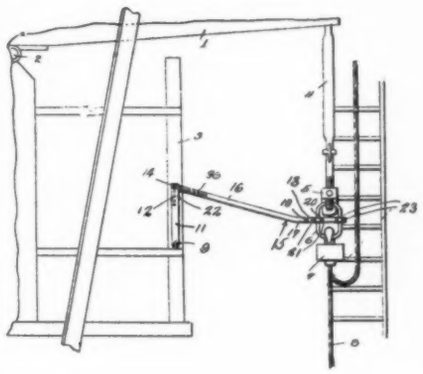
1. A pump jack construction embodying: a thrust member; a roller on said thrust member; and a rotatable cam member adapted to engage said roller and to impart movement to said thrust member, said cam member comprising a rotating body element having two cam elements thereon, one of said cam elements being circumscribed by the other; oppositely disposed gate members adapted to admit the passage of said roller from one of said cam elements to the other of said elements and mechanical means interposed between said gate members adapted to co-operatively effect opposite movement of said gates.

1,743,867. PYROMETER WELL. Foster Malic Poole, Tulsa, Okla., assignor to The Brown Instrument Company, Philadelphia, Pa., a Corporation of Pennsylvania. Filed Apr. 27, 1927. Serial No. 187,004. 6 Claims. (Cl. 73—32.)



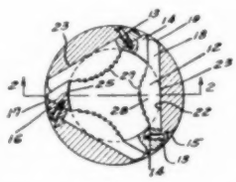
1. A pyrometer well comprising a head adapted to be secured in an opening in the wall of a container and made of a material having a relatively high thermal coefficient of expansion and an elongated tube portion secured to said head and formed of a material having a lower coefficient of expansion than the material of the container, but which is more highly resistant to corrosion than the head material.

1,734,817. JOCKEY STICK. Beech R. Mansfield, Seminole, Okla. Filed Nov. 26, 1927. Serial No. 235,929. Two Claims. (Cl. 255—11.)



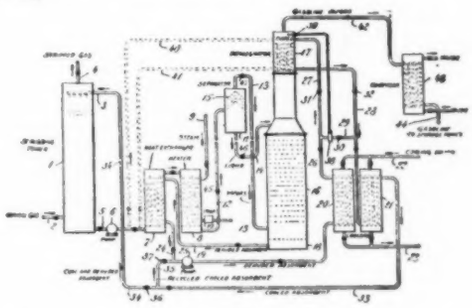
1. In a device of the class described, a radius arm provided at one end with bifurcations, and supplied at its opposite end with a laterally off-set sleeve, a pivot element mounted in the sleeve, a link, means for connecting one end of the link adjustably between the bifurcations of the radius arm, and means mounted on the opposite end of the link for holding a line clamp against rotation.

1,743,455. FISHING TOOL. William M. Jenkins, Fullerton, Calif. Filed Apr. 27, 1927. Serial No. 186,903. 12 Claims. (Cl. 294—90.)



1. A fishing tool having a lower tubular section with a plurality of jaws, each jaw pivotally mounted at one of its ends and each jaw swinging upwardly in a vertical plane parallel to the axis of the tubular section, means in the tubular section to support the free ends of each jaw with the main portion of the jaws normally occupying substantially a horizontal position, the tubular section having flat surfaces behind and outside of each jaw forming a backing therefor in the swinging movement of said jaws upwardly, the jaws when in an upper position allowing passing of the tubular section over an enlarged part of the fish, and when in a horizontal position engaging an enlargement of a fish.

1,743,185. RECOVERY OF GASOLINE. Harold B. Bernard, Tulsa, Okla., assignor to Sinclair Oil and Gas Company, Tulsa, Okla., a Corporation of Maine. Filed Apr. 17, 1925. Serial No. 23,828. 4 Claims. (Cl. 196—8.)



1. A process of separating absorbed hydrocarbon constituents from liquid absorbing mediums, which comprises heating the charged medium without any substantial separation of vapors therefrom, reducing the pressure thereon and after the pressure reduction effecting a separation of vapor and liquid constituents, and passing the separated liquid constituents in countercurrent flow and in direct contact with the separated vapor constituents.

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